2006

BIOLOGICAL OPINION ON THE OPERATION OF THE MISSOURI RIVER MAIN STEM SYSTEM, MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT, AND OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM

2006 ANNUAL REPORT

**BIOLOGICAL OPINION ON THE
OPERATION OF THE MISSOURI RIVER MAIN STEM SYSTEM,
MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT,
AND OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM**

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2006 Annual Report

Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System

Table of Contents

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF ACRONYMS AND ABBREVIATIONS

Acronyn/ Abbreviation	**Phrase**
ACT	Agency Coordination Team
AOP	Annual Operating Plan
BA	Biological Assessment
BiOp	Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System dated November 30, 2000 and amended December 16, 2003
BSNP	Missouri River Bank Stabilization and Navigation Project
cfs	Cubic feet per second
Corps	U.S. Army Corps of Engineers
CR	Conservation Recommendations
CRP	Construction reference plane
CSRP	Comprehensive Sturgeon Research Program
CWA	Clean Water Act
CY	Calendar Year
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESH	Emergent Sandbar Habitat
FONSI	Finding Of No Significant Impacts
FY	Fiscal Year

GPS	Global Positioning System
GIS	Geographic Information System
LHRHa	Leutinizing Hormone/Releasing Hormone analogue
MAF	Mean acre feet
MNRR	Missouri National Recreational River
MRNRC	Missouri River Natural Resources Committee
MRRIC	Missouri River Recovery Implementation Committee
msl	Mean sea level
MTFWP	Montana Department Fish, Wildlife, and Parks
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NGPC	Nebraska Game and Parks Commission
PgMP	Program Management Plan
RM	River Mile
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measures
SFH	State Fish Hatchery
SWH	Shallow Water Habitat
USFWS	U.S. Fish and Wildlife Service
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

2006 Annual Report

Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System

Introduction. The U.S. Army Corps of Engineers (Corps) prepares an annual report for interested parties in accordance with the reporting requirements of the "Biological Opinion (BiOp) on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP), and Operation of the Kansas River Reservoir System" prepared by the U.S. Fish and Wildlife Service (Service) dated November 30, 2000 and the Amendment, thereto, dated December 16, 2003.

This annual report documents the Corps threatened and endangered species conservation activities to comply with the provisions of the 2000 BiOp and the 2003 Amendment to the BiOp for the calendar year (CY) 2006. Only those items that are required for CY 2006 or have been accelerated in the BiOp schedule are included. Corps conservation activities and progress in implementation of the elements of the Reasonable and Prudent Alternative (RPA), Reasonable and Prudent Measures (RPM), and Conservation Recommendations in the 2003 amended BiOp for the FY 2006 are summarized as follows.

I. Pallid Sturgeon (*Scaphirhynchus albus*): 1) shallow water habitat (SWH) design and construction activities, 2) pallid sturgeon propagation/augmentation support, 3) pallid sturgeon population assessment implementation, and 4) research, monitoring and evaluation activities.

II. Least Tern & Piping Plover (*Sterna antillarum* & *Charadrius melodus*): 1) preparation of a programmatic environmental impact statement for emergent sandbar habitat creation activities, 2) emergent sandbar habitat (ESH) creation, 3) research, monitoring and evaluation efforts, 4) Reasonable and Prudent Measures, and 5) other research efforts.

III. Ecosystem: 1) Bald Eagle Research.

IV. Missouri River Comprehensive Recovery Program: 1) Missouri River Recovery Implementation (including the Missouri River Master Water Control Manual Review and Update), 2) Mainstem Water Management in FY 2006, and 3) Mainstem Water Management FY 2006 litigation.

I. PALLID STURGEON

I.A. Shallow Water Habitat Design and Construction Activities

I.A.1. Omaha District

a. Design Activities. A number of shallow water habitat (SWH) design activities were completed in FY 2006. A summary is provided below.

1. Completed 90% Plans and Specifications (Plans and Specs) for the Tyson Bend Chute. The Tyson Bend project is located at the Iowa Department of Natural Resource's Tyson Bend Wildlife Management Area in Harrison County, Iowa, on the left (east) bank of the Missouri River between river miles (RM) 653 and 655.5. The Tyson Bend chute is approximately 13,300 linear feet of river chute. An additional 9,933 feet of backwater would be added to the existing backwater at Tyson Bend.

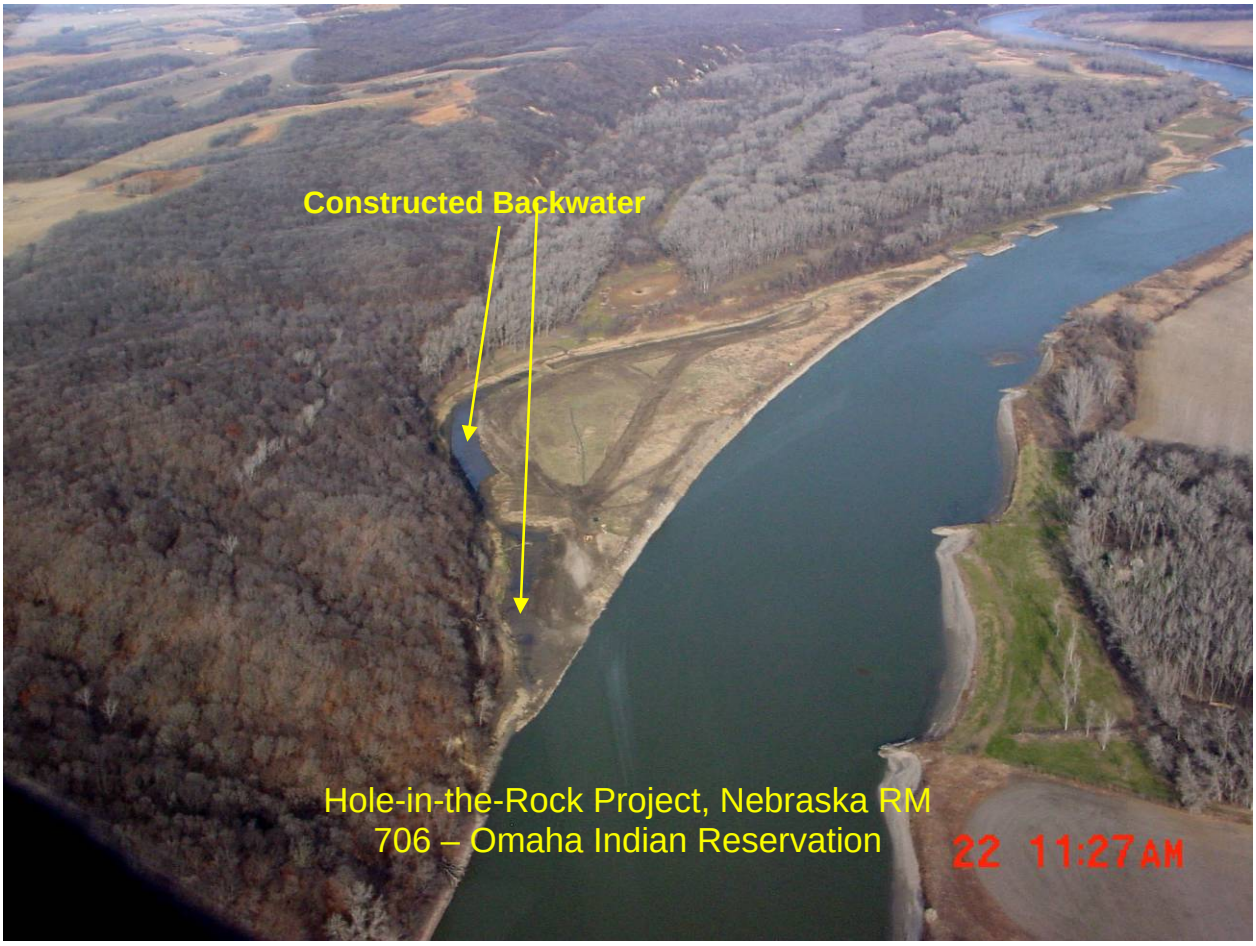
2. Completed Plans and Specs for the DeSoto Bend Revetment Notching. This project consists of the removal of portions of the left bank revetment between the RM 644 and 642. This will provide depth diversity and resting areas along the outside of the bend.

3. Completed 35% Plans and Specs for Fawn Island. Fawn Island is a pilot chute along the left bank of the river near RM 673.6. This will provide diverse depths along the outside of the bend. The length of the chute is approximately 1/2 mile.

4. Completed 90% Plans and Specs for River Structure Control Modifications from Sioux City to Rulo (25 Bends). This work is an expansion and continuation of the work that was completed in 2004.

b. Construction Activities. The Omaha District had two SWH construction activities in FY 2006. A brief description of each activity follows:

Hole-in-the-Rock, RM 706, Right Bank (Nebraska, Omaha Indian Reservation). This project is part of the original mitigation program and consists of a dredged backwater. The backwater is a historic remnant of an oxbow that was created when the BSNP was constructed. This site is also a significant religious and cultural area for the Omaha Indian Tribe. The constructed project will create a backwater with varying depths, widths, and side slopes that will provide 7 to 10 acres of SWH once complete. The project was functionally complete in June 2006. A picture of the project is shown below.



Photograph 1. Hole-in-the Rock Project, RM 706

River Control Structure Modification. A contract was issued for a river control modification in the reach from Sioux City to the Platte River. This contract was issued in June. However, work did not begin until September due to supply problems at the quarries. The contractor was able to complete only a minor

portion of the work before the end of the navigation season. The work will resume in the spring of 2007. A minimal number of acres was realized in 2006.

I.A.2. Kansas City District

a. Design Activities. Several design activities were completed in FY 2006. A summary is provided below.

Completed Plans and Specs for two 4,500 foot long chutes at Baltimore Bend, RM 298, right bank. Baltimore Bend is part of the Service's Big Muddy National Fish and Wildlife Refuge. Construction is scheduled to be completed by spring 2007. Work will be accomplished by in-house labor crews.

Completed 65% Plans and Specs for a third chute at Baltimore Bend. This third chute will be 100 feet wide and 12,600 feet long and located landward of the two smaller chutes mentioned above. Current plans are to contract construction of the longer chute and for excavation of the chute to be accomplished by hydraulic dredge. Final Plans and Specs should be ready for advertisement by early spring 2007.

Completed 35% Plans and Specs for a chute at Barney Bend, RM 550, left bank. This chute will be 75 feet wide and around 8,000 feet long. Current plans are to contract for construction of the chute with excavation by hydraulic dredge. Final Plans and Specs could be ready for advertisement by late summer 2007.

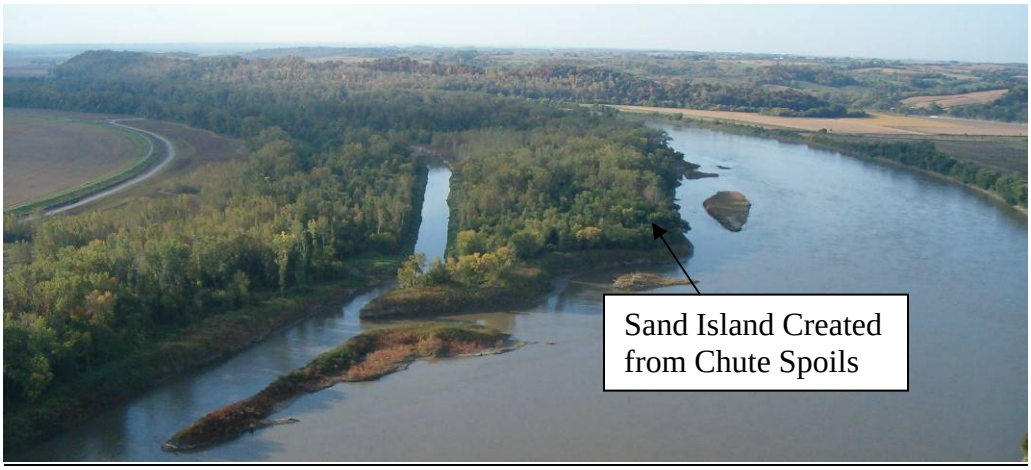
Construction of the Tarkio River Delta (TRD) project has been contracted for as part of the Rush Bottoms chute project. The TRD project consists of the excavation of two tributaries of the Tarkio River. Construction should be started and completed during winter 2006 or 2007.

The District continues to monitor existing prototype SWH projects to further the Corps understanding of how the river responds to the various types of projects. This monitoring will refine our design guidelines and lead to better projects over time as the refined guidelines are incorporated into new and existing projects. Lessons learned from this monitoring effort have been incorporated into a Lesson Learned report that was sent to the Service in late spring 2006.

b. Construction Activities. The Kansas City District had six SWH construction activities in FY 2006. A brief description of each activity follows.

During summer of 2006, two new dikes were constructed at RM 161 and 275 in response to channel dimensions that were less than the authorized 8 feett (minimum service) depth. The new dikes were designed and constructed to not only improve channel conditions but also to preserve and possibly enhance existing SWH.

Worthwine Island Chute, RM 458, Left Bank [Missouri Department of Conservation (MDC)]. This project was restarted and completed after being suspended for funding reasons at the beginning of the previous FY. The chute was approximately 50% complete when work was suspended. The chute is 75 feet wide and 9,800 feet long. The contractor excavated the chute by trackhoe, with spoils used to build stability berms for the adjacent Federal levee and end dumped into the river to create temporary sand islands. A picture of the upper end of the project is shown below.



Photograph 2. Worthwine Island Chute, RM 458

Rush Bottoms Chute, RM 502, Left Bank. A contract for construction of a 75 feet wide and 10,000 feet long chute at Rush Bottoms was awarded in mid-summer. The contractor chose to excavate the chute by hydraulic dredge. By the end of September 2006, the bottom 1,500 feet of the chute was fully excavated. The contractor plans to suspend dredging during the winter when stages are low and resume dredging in the spring. A picture of the lower 1,500 feet is shown below.

Photograph 3. Rush Bottoms Chute, RM 502

Tadpole Island Chute, RM 175, Right Bank. An 80 feet wide and 9,800 feet long chute was constructed during the winter by in-house work crews at Tadpole Island. The chute is located at the downstream end of Overton Bottoms which is owned by the Corps and managed by MDC. Spoils were placed along the sides of the chute and coarsely graded. It is anticipated that as the chute widens the spoils will slough into the chute and be transported out into the river by flows through the chute.

Photograph 4. Tadpole Island Chute, RM 175

Pelican Island Dike Extensions and Notching, RM 18, MDC. Ten dikes around Pelican Island were extended and notched. This work was included as two line items in the FY 2006 river structure maintenance contract. The riverward end of the dikes was extended 50 feet to 100 feet and the landward portion of the same dikes was notched 100 feet to 150 feet. In addition to creating habitat, the notches ensure the extensions do not adversely affect flow conveyance. Similar dike extensions and notching constructed at Lisbon during 2004 resulted in significant submerged sandbar formation downstream of the extensions and creation of secondary channels near the bank. The resulting habitat had a high degree of diversity and complexity. In FY 2007, an additional 10 dikes at Howell Island (RM 45) will be extended and notched as part of this contract.

Photograph 5. Pelican Island Dike Extensions and Notching, RM 18

Bank Notch and Revetment Chute Construction at Wolf Creek, RM 480, Left Bank. District in-house work crews constructed 11 bank notches and one 3,200 feet long revetment chute at Wolf Creek Bend. The property was purchased by the Corps and is currently managed by the MDC. Over 350,000 cubic yards of material were excavated for the project with all material disposed of directly into the river. Resulting bank notches are 75 feet wide excavated down to 3 feet below minimum navigation stages. The revetment chute has a bottom width of 100 feet and was excavated to 4 feet below minimum navigation stages. Lessons

learned from previous bank notch and revetment chute construction were incorporated into the design and construction.

Photograph 6. Bank Notch Construction at Wolf Creek, RM 480

Photograph 7. Revetment Chute Construction at Wolf Creek, RM 480

Notch Lowering, RM 140 to RM 10. Ninety-two existing notches were lowered by contractor. The work was included as a line item in the FY 2006 river structure maintenance contract. The lowered notches are all located below Jefferson City, Missouri. The notches were lowered either because they originally were not excavated deep enough to create shallow water habitat (notches originally constructed prior to BiOp) or bed degradation had diminished the effectiveness of the notches in creating shallow water habitat. An additional 100 notches will be lowered in FY 2007 as part of this contract line item.

Jameson Island Chute, RM 214, right bank. A contract for a 100 feet wide and 10,000 feet long chute at Jameson Island was awarded in late September. Jameson Island is part of the Service's Big Muddy Fish and Wildlife Refuge and is located immediately downstream of Lisbon Bottoms. The contractor has chosen to excavate the chute by dredge with work anticipated to begin in spring 2007.

I.B. Pallid Sturgeon Propagation/Augmentation Support

The Pallid Sturgeon Propagation and Population Augmentation Program (Program) utilizes 6 hatcheries throughout the Missouri River basin to meet the stocking needs of the species. These hatcheries include the Blind Pony State Fish Hatchery (Blind Pony Hatchery), Sweet Springs, Missouri, the Neosho National Fish Hatchery (Neosho Hatchery) , Neosho, Missouri, the Gavins Point National Fish Hatchery (Gavins Point Hatchery), Yankton, South Dakota, the Garrison Dam National Fish Hatchery (Garrison Dam Hatchery), Riverdale, North Dakota, the Miles City State Fish Hatchery (Miles City Hatchery), Miles City, Montana, and the Bozeman Fish Technology Center (Bozeman FTC), Bozeman, Montana.

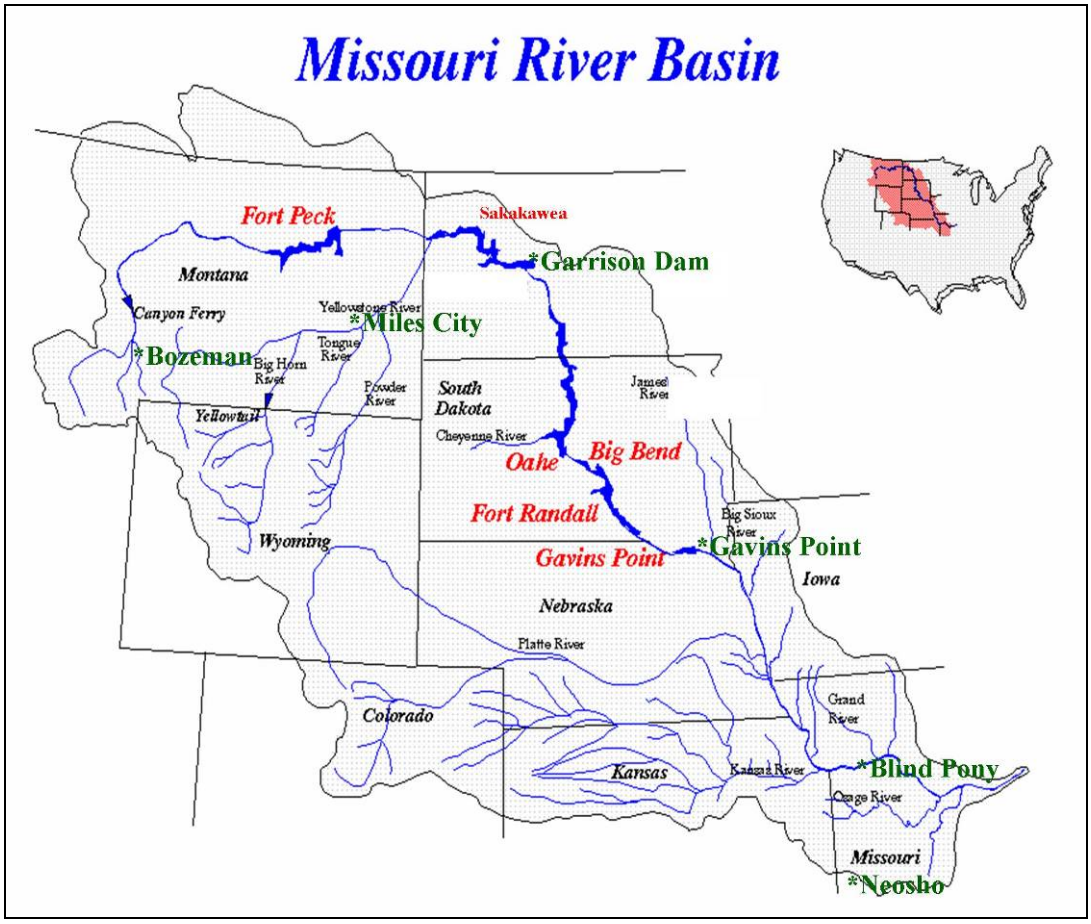


Figure 1. Map showing the locations of the Pallid Sturgeon hatcheries participating in the Propagation and Population Augmentation Program

The Program consists of two primary components at the present time. The Annual Supplemental Support Component as derived based on the 2000 BiOp (and 2003 Amendment) and the Facility Improvements Component as outlined in the Corps 2003 Missouri River Biological Assessment. The Annual Supplemental Support component of the program provides resources to each of the participating hatcheries as determined by the Program's Product Delivery Team (Pallid Propagation Team) to ensure the most equitable use of the program's resources to meet the stocking needs of the species. The Facility Improvements component of the program is a short-term approach to addressing limitations of the hatcheries in meeting annual stocking targets. The intent of this component is to increase the quantity and the quality of the hatchery produced pallid sturgeon to more effectively fulfill the stocking goals in each of the Recovery Management Units within the Missouri River System. The combination of these two

programmatic components enables the effort to focus on the population augmentation needs of the pallid sturgeon relative to recovery of the species.

Pertaining to all of the facilities, a portion of the Annual Supplemental Support offsets costs associated with feed, utilities, distribution costs, various maintenance items, and operational costs incurred through the facility improvements component of the program.

The benefits of a collective approach to capturing, spawning, and rearing pallid sturgeon is critical to the overall success of the population augmentation program. Multi-agency cooperative efforts were put forth targeting broodstock collection efforts in North Dakota in the fall of 2005 and spring of 2006 resulting in the capture of 6 female and 30 male pallid sturgeon. A total of 28 additional fish were captured from the Missouri (below Gavins Point Dam) and Mississippi Rivers in late fall of 2005 and winter of 2006 through Pallid Sturgeon Population Assessment sampling and other research sampling activities. All of these fish were transported to the Gavins Point Hatchery. However, only one female was successfully spawned of two potential female candidates. Four of the 6 females originating from North Dakota were successfully spawned. Because of the integrated/multi-hatchery approach to the propagation program, the overall effort was successful despite setbacks occurring at different stages of propagation at individual facilities. For example, two hatcheries were successful regarding spawning of the female pallid sturgeon at their respective hatcheries. The third hatchery was not successful in spawning the two females on station. However, the successful spawning of males at the third hatchery was critical to the overall success of the spawning effort as milt was transported to the other two hatcheries. This enabled them to maximize the genetic diversity by following the recommended genetic pairings for the pallid sturgeon available. Additionally, eggs were distributed between the facilities which maximized the program's ability to continue forward with propagation efforts with the rearing phase. During the rearing phase, two hatcheries experienced complete or near complete mortality. But because the eggs had been spread amongst these hatcheries to serve as a redundant effort, enough progeny were produced so that stocking targets can still be met for the 2006 year class.

Additional fall broodstock collection efforts have taken place in October-November of 2006. Five adult pallid sturgeon were captured in October through multi-agency cooperative netting efforts on Lake Sharpe. Four of these fish are currently being held at the Gavins Point Hatchery (one fish did not survive). These fish will be evaluated for use in the propagation program and will also have genetic samples analyzed to further refine our understanding of the genetic makeup of the population and assess genetic differences based on geographic location.

An additional six adult (4 females, 2 males) pallid sturgeon were also captured through multi-agency cooperative netting efforts in late October/early November in North Dakota near the confluence of the Missouri and Yellowstone Rivers. These fish were also transported to the Gavins Point Hatchery for spawning efforts in the spring of 2007.

In Mid-November, the Great Plains Fish and Wildlife Management Assistance Office captured an adult pallid sturgeon while conducting standardized Pallid Sturgeon Population Assessment gill netting in the Fort Randall reach. This adult was also transported to the Gavins Point Hatchery for potential use in spawning efforts in 2007.

A variety of fish marking methods have been utilized to identify hatchery fish which enhances scientists' understanding of the species (i.e., growth, movement, survival). The PIT tag provides the maximum amount of information specific to individual fish. Smaller juveniles (that cannot be PIT tagged based on size) are marked with tags such as elastomer tag (visual) or a coded wire tag. These tags provide less information, but at a minimum differentiate between hatchery and wild fish. In the event of no tag, as is the case when fry (<20 days old) are stocked, the genetic tools are now available to differentiate these stocked fish from those that are naturally reproduced.

I.B.1. Bozeman Fish Technology Center (Bozeman FTC)

Attempts to collect wild pallid sturgeon broodstock from the Missouri River above Fort Peck Reservoir were unsuccessful in 2006. Therefore, there was no streamside spawning with genetic representation of the few remaining fish from above Fort Peck Reservoir. The Bozeman FTC took the lead role in spawning adult broodstock at the Miles City Hatchery from successful broodstock collection efforts originating from the Missouri and Yellowstone Rivers in North Dakota. Refer to the section for the Miles City Hatchery for details regarding spawning. Bozeman FTC received eggs representative of two family crosses from successful spawning efforts at the Miles City Hatchery and five family crosses from the Gavins Point Hatchery. This sharing of eggs between facilities minimizes the chances of losing entire genetic crosses and works toward maximizing the effective population size of the augmented population in the various stretches of the Missouri River. Egg hatch success was poor with a range of 0 to 17.5 percent. However, despite low hatching success, target numbers of the 2006 year class are currently being reared at the facility. Eggs received from the Miles City SFH were solely for experimental use. However, there were excess eggs (2,000 total excess) from the second spawn used for propagation. Percent hatch of the excess eggs was estimated at 85% hatch success and survival to age two months was 24.5%. Eggs received from the Gavins Point Hatchery were solely for propagation efforts. Percent hatch ranged from 25% to 50% and a survival to age two months ranged from 0.14% to 1.7%.

A variety of commercial grade feeds (Cyclo-peeze, BioDiet, and Silver Cup) were fed and mean water temperature was relatively constant at 61˚ Fahrenheit (F) throughout the year with a range of 59˚F to 63˚F. The water supplies at the facility include a cold spring and a warm spring providing diversity in the water supply for propagating pallid sturgeon. Water treatments include ultraviolet disinfection, sand and bio-filtration, and both heating and chilling water depending upon the time of year.

Fish health inspections tested positive for the iridovirus for the first time at the facility in the fall of 2006. Decisions as to whether the fish can be stocked, utilized for research or other purposes has yet to be determined.

The facility stocked a total of 3,375 pallid sturgeon representative of the 2005 year class during the summer of 2006 in the Missouri River above Fort Peck Reservoir.

Diet Research. In 2004, the facility received resources for fish feed manufacturing equipment to develop diets to meet the nutritional needs of the pallid sturgeon as identified in the 2003 Biological Assessment. In FY 2006, the Bozeman FTC conducted a diet study at the Garrison Dam Hatchery evaluating two experimental diets and a commercial diet (i.e., Bio Diet). The experimental diets did not perform as well as the BioDiet.

I.B.2. Miles City State Fish Hatchery (Miles City)

Miles City conducted spawning following the successful collection of two female and five male pallid sturgeon adults from the Yellowstone/Missouri River confluence area in North Dakota. Two females and three males were successfully spawned and milt from five additional males from the Garrison Dam Hatchery was also used to create a total of eight families. Family crosses were determined based on maximizing the genetic variability of the fish available for the spawning effort between hatcheries. Luteinizing Hormone - Releasing Hormone analogue (LHRHa) was administered to induce spermiation and ovulation with males being injected at a rate of 0.02 milligrams (mg)/kilograms (kg) of body weight and females injected at 0.05mg/kg body weight. A total of 135,200 eggs were spawned on station from these two females. Eggs were of good quality with an 85% hatch success. The majority of the eggs were transferred to the Garrison and Gavins Point hatcheries, the Bozeman FTC, and the Bluewater State Fish Hatchery in Montana to maximize the potential for collective success in rearing these fish to meet stocking targets.

Although spawning was highly successful and egg quality was good, two power outages caused failure in the function of the chiller resulting in temperature spikes ranging from 60˚F to 76˚F during incubation and immediately following hatching. This temperature spiking resulted in 100 percent mortality of the 2006

year class at the Miles City Hatchery. Resources have been provided for a smaller chiller that will meet water chilling needs during incubation and early life stage in the future and will function during power outages utilizing a generator.

A variety of commercial feeds was used (Bio Diet, Silver Cup). In FY 2006, water temperature ranged from 45-72º F with a mean temperature of 45ºF from November through April and mean temperatures of 52 (May), 63 (June), 63 (July), 68 (August), 60 (September), and 55 (October). The primary water source is from the Yellowstone River and a well with limited water capacity. All water is filtered, ultraviolet disinfected, and heated (boiler) or chilled to provide optimum temperature to achieve growth and maintain health.

Fish health inspections tested negative for the iridovirus for all family lots. However, Whirling Disease was diagnosed in trout that were being used for forage at the facility. To assess the susceptibility of pallid sturgeon to Whirling Disease, an experiment was conducted at the Pony Whirling Disease Experimental Station to expose pallid sturgeon to Whirling Disease Tams for 90 days. All testing came back negative.

A total of 2,397 pallid sturgeon were stocked in the Missouri and Yellowstone Rivers in April (1,041) and July (1,356). These fish were representative of the 2005 year class. An additional 282 pallid sturgeon from the 2004 year class were released with radio tags for a telemetry research project on the Yellowstone River.

I.B.3. Garrison Dam National Fish Hatchery (Garrison)

Wild broodstock collected from the Yellowstone/Missouri River confluence area in North Dakota provided two females for the propagation effort at Garrison in 2006. In addition to these two females, a total of 22 males were captured and held at Garrison with the intent to utilize the males for spawning and/or to add their genetics to the repository via sperm cryopreservation. Male pallid sturgeon were injected with LHRHa at a rate of 0.02 mg/kg of body weight and 0.05mg/kg body weight for females. Neither of the female pallid sturgeon ovulated and were returned to the river. Milt from multiple males was collected and utilized in the successful spawning efforts at the Gavins Point Hatchery. The Corps Northwestern Division plane was utilized to transport milt from male pallid sturgeon held at the Garrison Dam NFH to the Gavins Point NFH to maximize the genetic variability by crossing the most unrelated male and female pallid sturgeon available in the propagation effort. Milt from 21 males was added to the cryopreservation repository bringing the total male representation to a total of 73 pallid sturgeon (all from Upper Basin origin) before returning these fish to the river.

Although successful spawning of the two females did not occur at the Garrison Hatchery, eggs from successful spawning efforts at the Miles City (32,586) and Gavins (57,600) hatcheries were transferred to the Garrison hatchery for rearing in accordance with stocking targets. Egg hatch rates for eggs from the Gavins hatchery ranged from 34-84%. However, survival to two weeks post-hatch for these progeny was <1%. Egg hatch rates for eggs from the Miles City hatchery ranged from 12-74% for 7 families with a survival rate of 42% to date.

BioDiet (starter diets) and Silver Cup Salmon #2 and #3 were fed exclusively with the exception of the feed trials conducted by the Bozeman FTC. The water source for the facility is Lake Sakakawea (i.e., Missouri River). Water treatments include filtration (at 40 microns), ultraviolet disinfection (at a rate of 105-530 mJ/cm^2), heating with boilers, and degassing with packed columns. Mean water temperatures were 67 (Oct), 65 (Nov), 64 (Dec), 61 (Jan), 55 (Feb), 52 (Mar), no temperature data for April and May (as there were no production fish on station at this time), 69 (Jun), 67 (Jul), 69 (Aug), and 65 (Sep) and the temperatures ranged from 51-73ºF throughout the year.

Fish health inspections tested negative for the iridovirus for all family lots through two fish health inspections (i.e., March and October 2006).

Juvenile pallid sturgeon (3,970) were stocked in the Missouri River in Montana in April, 2006. These fish were progeny from the 2005 year class. An additional 4,922 fish representing the 2006 year class were stocked in October 2006 in the Yellowstone and Missouri Rivers in Montana and North Dakota. The

Garrison hatchery has over 8,500 juveniles on station from the 2006 year class that will be stocked out in the spring of 2007.

The facility participated in the diet evaluation test trials utilizing the developmental diets produced by the Bozeman FTC.

Facility improvements included the purchase and installation of 14 circular tanks 5 feet in diameter and 4 circular tanks 8 feet in diameter resulting in an increase in maximum production capability from 5,229 to 8,556 eight inch pallid sturgeon based on the recommended holding densities. An upgrade of the ultraviolet disinfection system providing increased protection achieving recommended treatment rates was also accomplished. The backup ultra-violet disinfection system in the Salmon Building was also upgraded to achieve the targeted rates.

I.B.4. Gavins Point National Fish Hatchery (Gavins)

In the fall of 2005, two female and three male adult pallid sturgeon were captured in North Dakota in the Yellowstone/Missouri River confluence area. These adults were transported to the Gavins Point hatchery and then successfully spawned in the spring of 2006. Spermiation and ovulation were induced utilizing LHRHa in both the males and the females. Males were injected at a rate of 0.02mg/kg of body weight and females were injected at 0.10mg/kg body weight. The two female pallid sturgeon originating from North Dakota were successfully spawned. Milt from males spawned at the Garrison hatchery was critical to the success of the efforts at the Gavins hatchery to create the recommended genetic crosses. A total of 9 families were produced from the Upper Basin spawning effort at the Gavins hatchery.

An additional 28 wild pallid sturgeon were brought in from the Missouri River between Gavins Point Dam and the mouth and from the Mississippi River. All of these fish were evaluated by U.S Geological Survey (USGS) (Mark Wildhaber and Janice Bryan) for sex and stage of maturity. Of these 28 fish, only one proved to be a female that was successfully spawned and the eggs were crossed with a captive male originating from the first successful spawning efforts at the Blind Pony hatchery dating back to 1992. The majority of the male pallid sturgeon collected was sexually immature and the females that held high potential for spawning did not ovulate as anticipated. Speculation as to why the females did not ovulate relates to temperature differences between the geographic location at which they were captured and moving them into the hatchery environment where temperature regimes were different from the capture locations. A portion of these fish were captured at a time that may have been close to the spawning time and the reduced water temperatures at the hatchery may have suppressed spawning.

Eleven males were added to the cryopreservation repository at the hatchery bringing the total males stored at the hatchery to 64. There is some redundancy in the milt stored between the Garrison and Gavins hatcheries providing a backup for the genetic repository.

The combined result of the spawning activities at the Gavins hatchery yielded over 467,000 eggs. A portion of the eggs were shipped to the Neosho, Bozeman, and Garrison hatcheries to maximize production capabilities to meet stocking targets and to serve as a backup in the event of catastrophic loss at the Gavins hatchery. Forty-six percent of the eggs retained on station hatched. An additional 15,200 eggs were received at the facility from spawning efforts at the Miles City hatchery. Eggs from the Miles City hatchery were incorporated into the hatchery production program as well as the future captive broodstock component of the program.

BioDiet and Silver Cup #2 and #3 were the primary commercial feeds fed to production fish. The primary diet for the future captive broodstock was live fish (rainbow trout).

Water sources for the hatcheries include Lewis and Clark Lake (Missouri River) and two wells which provide variability and a means of controlling temperatures to minimize extremes, such as, warm temperatures in the summer from the Missouri River and winter temperatures approaching freezing. The Missouri River water is filtered and undergoes ultraviolet disinfection. Water temperatures ranged from

41-70ºF. Monthly mean water temperatures were 54 (Oct), 45 (Nov), 43 (Dec), 45 (Jan), 45 (Feb), 47 (Mar), 52 (Apr), 57 (May), 65 (Jun), 68 (Jul), 68 (Aug), and 65 (Sep).

Fish health inspections in 2006 resulted in a clean bill of health relative to the iridovirus for the 2006 year class. In 2006, a total of 3,404 juvenile pallid sturgeon representing the 2005 year class were stocked in the Missouri River between Fort Randall Dam and the Kansas/Missouri River confluence. An additional 1,988 pallid sturgeon from the 2006 year class were stocked in North Dakota and Montana in the Missouri and Yellowstone Rivers in November, 2006.

Since the Gavins Point Hatchery is the only facility currently holding future captive broodstock, the majority of the tank space is occupied by the future captive broodstock rather than by production fish for stocking. The future captive broodstock currently holds 10 year classes represented by a total of 88 genetic families to serve as a backup for the species in the event that wild broodstock are not obtainable in the future. A male from the 1992 year class of these captive broodstock was utilized to create a family cross with one of the females originating from the Mississippi River.

As identified in the 2003 Biological Assessment, a portion of the facility improvement component was funded for a new well and degassing station and water tower to provide for the long-term well water needs of the facility. The project will be completed in December 2006.

In addition to the well water project, funds were also provided for a fifth wheel trailer and six compartment tank distribution unit. The distribution unit will be completed in December, 2006 and will be available for all participating hatcheries for the sole-purpose of stocking pallid sturgeon throughout the Missouri River system.

I.B.6. Blind Pony State Fish Hatchery (Blind Pony)

The Blind Pony hatchery has undergone renovations in accordance with facility improvement items identified in the 2003 Biological Assessment. Due to these renovations which included renovation of the water supply (i.e., Blind Pony Lake), the facility was unable to participate directly with spawning and rearing activities of the pallid sturgeon in 2006. The lake renovation was completed in November 2005 as well as the water supply line upgrade (including water control structures) from the lake to the hatchery building area. The final phase of the renovation project was the construction of the building over the tank rearing area. This effort is now complete and all systems have been tested for functionality and have performed consistently with design expectations.

The facility will be on-line for pallid sturgeon spawning and rearing in 2007 provided adequate rainfall fully recharges Blind Pony Lake which serves as the water supply for the hatchery.

Although the Blind Pony Hatchery wasn't able to spawn or rear fish at the facility, hatchery personnel participated in the transportation of broodstock collected from the lower Missouri River into the Gavins Point hatchery utilizing the State of Missouri's plane and the Blind Pony Hatchery distribution truck.

I.B.7. Neosho National Fish Hatchery (Neosho)

The Neosho hatchery did not spawn adult pallid sturgeon in 2006. Neosho received 56,400 eggs from the spawning efforts at the Gavins Point hatchery in June. The percent hatch of these eggs at the Neosho hatchery was estimated at 50%. The facility experienced extremely high mortality during the early life stages following hatching and essentially lost all progeny. In early November 2006, only 8 fish remained.

The Neosho hatchery stocked a total of 1,254 juvenile pallid sturgeon at Rulo and Bellevue, Nebraska representative of the 2005 year class. These progeny were from Upper Basin origin (North Dakota), but were stocked in the lower basin since progeny originating from local broodstock were unattainable.

The hatchery fed natural diets (i.e., brine shrimp and bloodworms) exclusively to all sizes of pallid sturgeon. The hatchery water supply is spring water. Water treatments include ultraviolet disinfection

which is necessary due to the recirculation (reuse) of water between tanks. Water is heated on a limited basis to provide temperatures to optimize growth. Temperatures ranged from 50-70ºF over the course of the year. The monthly mean temperatures were 69 (Oct), 69 (Nov), 69 (Dec), 69 (Jan), 69 (Feb), 69 (Mar), 69 (Apr), 69 (May), 54 (Jun), 54 (Jul), 69 (Aug), and 69 (Sep).

Fish health inspections resulted in positive testing for the iridovirus (low levels) of the 2005 year class.

The Neosho hatchery has been undergoing expansion in the form of a building and tanks since 2004 in order to increase their spawning and production capabilities. This construction is one of the facility improvement projects identified in the 2003 Biological Assessment. The building was complete as of October, 2006 but some electrical work, receipt of tanks, and internal plumbing still need to be installed to make the facility expansion functional to spawn and rear fish. The effort will be completed in January, 2007 enabling the facility to spawn and rear pallid sturgeon at full capacity in 2007. Once fully functional, the facilities maximum production capability will increase from 4,500 fish to nearly 20,000 fish.

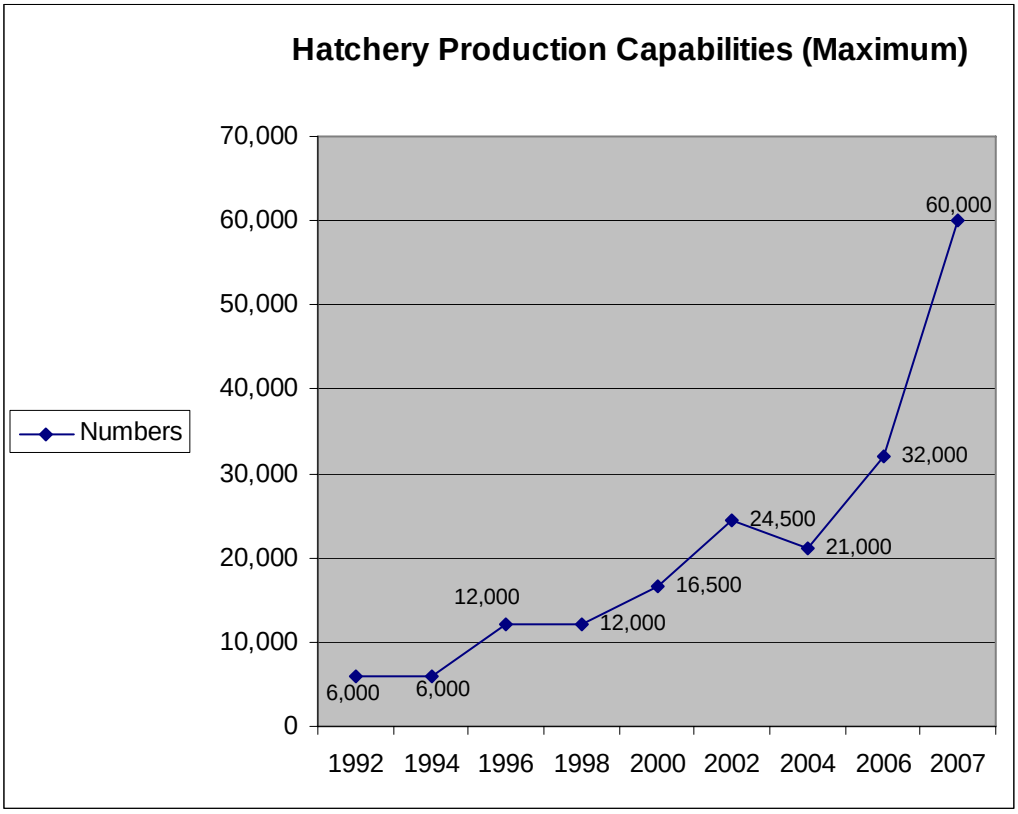


Figure 2. Collective Maximum Hatchery Production Capabilities for the Gavins Point, Garrison Dam, Miles City, Blind Pony, Neosho Hatcheries, and the Bozeman FTC

Figure 2 is based on maximum allowable densities of 0.5 pounds of fish per square foot of rearing space and fish length of approximately 8 inches (fork length). Note that the hatcheries will operate at densities below the recommended maximum allowable levels to minimize stress that would likely reduce the overall quality of the fish and potential for successful stocking. The projections for 2007 are based on the Blind Pony and Neosho Hatcheries being fully operational including facility improvement projects identified in the 2003 Biological Assessment. The graphic was based on 12,000 production fish at the Gavins Point hatchery annually which will decrease over time as additional future captive broodstock will occupy this rearing space thus reducing production capabilities for stocking.

I.C. Pallid Sturgeon Population Assessment Implementation

The Pallid Sturgeon Population Assessment Program has been developed by the Pallid Sturgeon Population Assessment Team (Team). The Team is comprised of representatives of state and federal agencies and academia that collectively possess knowledge and expertise of the Missouri River, pallid sturgeon, and native Missouri River fishes, research, experimental design, and statistical analysis. The program focuses on the endangered pallid sturgeon and a series of native Missouri River species as required in the 2000 BiOp and 2003 Amendment.

Figure 3. Pallid Sturgeon Population Assessment Team.

Objectives of the Program

1) Evaluate annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River System.

2) Evaluate annual results and long-term trends of habitat usage of pallid sturgeon and hatchery stocked pallid sturgeon by season and life stage.

3) Evaluate population structure and dynamics of pallid sturgeon in the Missouri River System.

4) Evaluate annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River system. These target species include: shovelnose sturgeon *S. platyorynchus*, blue sucker *Cycleptus elongatus*, sauger *Zander canadense*, plains and Western silvery minnows (*Hybognathus* spp.), sand shiner *Notropis stramineus*, and three main channel inhabiting cyprinids in the genus *Macrhybopsis:* sturgeon chub *M. gelida*, sicklefin chub *M. meeki*, and speckled chub *M. aestivalis*. These three chub species are the main forage for piscivorous pallid sturgeon and are rare in some sections of the Missouri River.

5) Evaluate annual results and long-term trends of habitat usage of the target native species by season and life stage.

6) Evaluate annual results and long-term trends in all remaining species (minimum of 50 fish collected/species) population abundance and geographic distribution throughout the Missouri River system.

Program Status Update

Full implementation of the program was achieved in 2006 with the Montana Fish, Wildlife and Parks coming on board to conduct sampling in segments 1-3 (Segment 1-Fort Peck Dam to the confluence of the Missouri/Milk River confluence, Segment 2-Milk River to Wolf Point, and Segment 3-Wolf Point to the Missouri/Yellowstone River confluence).

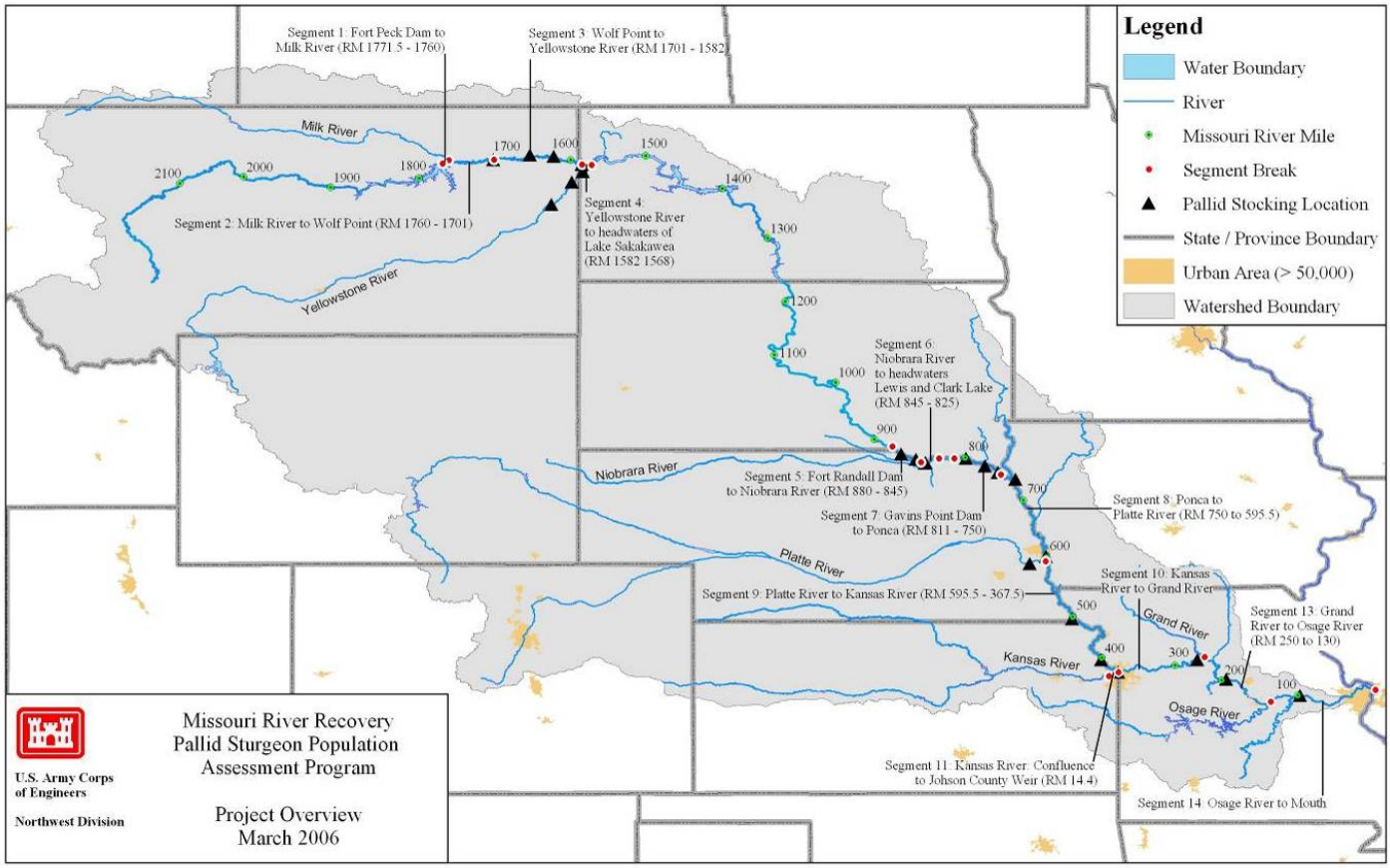


Figure 4. Missouri River Population Assessment Program Map
(Segment 12 was combined with segment 13 effective July 1, 2005).

2006 Summary Reports

The Standardized Reports for each segment (i.e., 1-14), executive summaries and combined program reports will be available on the following website listed under "Publications and Reports" after March 31, 2007: http://im4.nwo.usace.army.mil/intro/dms.dmsintro.main

A standardized reporting template has been developed by the Team which provides an overview of the findings in each segment for pallid sturgeon and the target native species under evaluation for this program. All tables and figures between segment reports are standardized, thereby facilitating easy comparisons

between segments for the standard sampling requirements of the program. Additional data collection efforts (above and beyond the standard requirements of the program) are also included in appendices within these reports.

I.D. Research, Monitoring and Evaluation Activities

I.D.1. Comprehensive Sturgeon Research Program

The Corps, in the 2003 Biological Assessment, committed to rigorous research in seeking to recover the listed species. The BiOp also called for rigorous research activities to help fill in the gaps of our understanding of the species life histories and their interaction with the habitat. The Pallid Sturgeon Research Program is the tool we have chosen to ensure that research is being carried out for the pallid sturgeon. The Comprehensive Sturgeon Research Program (CSRP) began in 2004. Since that time, research activities have been implemented each year to gather information on adult behavior and other areas of the pallid life history that are thought to be limiting factors to recovery.

The Research Program will be a team led process like the other pallid sturgeon program elements. The development of the team is underway and a team of representative scientists will be in place in 2007. The team will further develop the research process for requesting and receiving research proposals and refining the prioritization process necessary to ensure the highest priority actions are funded.

Objectives of the Program

Objectives for the program will be developed by the team, but, in general, the objectives of the program are to: 1) identify information gaps and solicit proposals to address the gaps, 2) ensure implement high priority research activities, and 3) ensure that information is fed into the conceptual model and the adaptive management process.

Program Status Update

In 2006, ongoing research activities, CSRP, and Spring Rise Flow Modification (SRFM) were reviewed and implemented. A request for proposals for other research needs for the pallid was also conducted. Proposals received through that process will be reviewed and prioritized and, as money is available, funded. A continuation of the proposal process is to develop, prioritize, and contract for 2007 research activities for the pallid.

2006 Summary Reports

The reports for the CSRP will be available on the web listed under “Publications and Reports” after December 31, 2006 at: http://im4.nwo.usace.army.mil/intro/dms.dmsintro.main

I.D.2. Flow Modification (Spring Rise) Physical and Biological Evaluation

To evaluate the physical and biological responses to a spring rise, the Corps established a group of scientists to develop a study design through the Spring Rise Plenary Process. The Technical Working Group (TWG) developed the foundation for a 2006 study plan that would assess pallid sturgeon and habitat responses to the planned flow event. The foundation was refined by the Corps and a multi-agency workgroup until it was sufficient to gather pertinent data for the spring rise flow event. The plan addresses the priorities of the Spring Rise Technical Work Groups and the research priorities of the Ruckelshaus document. See previous reports for details of the monitoring plan.

The plan was funded for implementation in 2006, but delays in funding activities impacted the contractors ability to achieve all the objectives of the plan. There were delays in fish capture, tagging, and gear deployment because of the timeliness of FY 06 funds.

The Master Manual and the 2006 Annual Operating Plan described the flow event for spring 2006 based on water availability. Water storage in March precluded a pulse flow during that time period, but criteria were met in May and a pulse of water meeting predetermined volume was released approximately May 19, 2006. Monitoring was in place to track fish movement, aggregation and spawning, flow change, water quality change, and sediment changes due to the change in water release pattern. The fish and habitat response data collected was put into a database by USGS and is being uploaded to the GIS Enterprise system as it is ready for the information. Data summaries and annual reports for each component will be provided by December 31, 2006 to the contract manager for this project. Those reports will be combined to make an annual report for this activity. Overall analysis of the data will be conducted in the future as enough data is available for analyses.

The reports for SRFM will be available on the web listed under "Publications and Reports" after December 31, 2006 at: http://im4.nwo.usace.army.mil/intro/dms.dmsintro.main

I.D.3. Fort Peck Tests Biological Monitoring

The BiOp formally identified that seasonally atypical discharge and water temperature regimes resulting from operations of Fort Peck Dam have precluded successful spawning and recruitment of pallid sturgeon in the Missouri River below Fort Peck Dam. In response, the Corps proposes to modify operations of Fort Peck Dam to enhance environmental conditions for spawning and recruitment of pallid sturgeon. Modified dam operations include releasing warm surface water over the Fort Peck Dam spillway. The Fort Peck Flow Modification Biological Data Collection Plan (hereafter referred to as the Fort Peck Data Collection Plan) was initiated in FY 2001 to evaluate the influence of proposed flow and temperature modifications on physical habitat and biological response of pallid sturgeon and other native fishes. Research and monitoring activities conducted during FY 2006 as part of the multi-year Fort Peck Data Collection were similar to those activities conducted during 2001 – 2005, and included: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam, 2) examining movements and relocating adult pallid sturgeon, paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus* in the Missouri River between Fort Peck Dam and Lake Sakakawea and in the lower Yellowstone River, 3) quantifying larval fish distribution and abundance, 4) quantifying the reproductive success of shovelnose sturgeon and pallid sturgeon based on captures of young-of-year sturgeon, and 5) assisting in the collection of adult pallid sturgeon for the propagation program. The Fort Peck Data Collection Plan is supported by the Corps and is jointly implemented by the Montana Department of Fish, Wildlife, and Parks (MTFWP) and the USGS - Columbia Environmental Research Center. Similar to 2001 through 2005, proposed flow modifications were not implemented in FY 2006 due to inadequate precipitation and insufficient reservoir levels.

Activities associated with the Fort Peck Data Collection Plan during FY 2006 were partitioned between compiling and analyzing data from the FY 2005 field season and implementing the FY 2006 research and monitoring field components. Thus, this summary highlights findings from the FY 2005 data analyses in addition to summarizing field activities during FY 2006.

For research component 1, water temperature loggers were deployed at several sites inclusive of the Missouri River, Yellowstone River, selected tributaries, and off-channel areas from April 2005 through mid-October 2005. During this time period, water temperature averaged 17.6^{o} Celsius (C) in the free-flowing Missouri River upstream from Fort Peck Reservoir and 12.4^{o}C downstream from Fort Peck Dam. Thus, hypolimnetic releases from the dam thermally suppressed water temperatures by an average of 5.4^{o}C during the study period. Despite gradual increases in temperature as water flowed downstream from the dam, mean water temperature at Nohly (290 kilometer [km] downstream and just upstream from the Yellowstone River confluence) remained 0.7^{o}C cooler than water temperatures upstream from Fort Peck Reservoir indicating continued affects of hypolimnetic releases. Water temperature at Frazer Rapids, a target location for enhancing water temperature to 18.0^{o}C via spillway releases, exceeded 18.0^{o}C on only two dates during 2005 in the absence of spillway releases. Turbidity loggers were deployed from late-May through August 2005 in the Missouri River (Frazer Rapids, Poplar, and Nohly) and in the Yellowstone River. Turbidity during this time period increased from upstream to downstream sites below Fort Peck Dam, but was higher in the Yellowstone River than in the Missouri River. Periods of elevated turbidity

were associated with increasing discharge in both rivers. Water temperature loggers and turbidity loggers were deployed at the same sites and during the same time periods during the FY 2006 field season. These data will be compiled and analyzed by April 2007.

Under research component 2, extensive radio-tracking was conducted between April and November 2005 in the lower Yellowstone River and in the Missouri River between Fort Peck Dam and the headwaters of Lake Sakakawea. A total of 26 individual tracking events were conducted throughout the river systems resulting in a cumulative distance of 11,437 km tracked. We obtained 960 relocations of blue suckers, 389 relocations of paddlefish, and 1,047 relocations of shovelnose sturgeon via boat. Eight continuous-recording telemetry logging stations logged an additional 864 contacts of implanted fish. Species-specific information on locations and movement patterns were ascertained. In addition, a total of 345 manual relocations of pallid sturgeon were obtained. Radio-tracking of pallid sturgeon, shovelnose sturgeon, paddlefish, and blue suckers in the Missouri River and lower Yellowstone River continued during FY 2006. From April through July 2006, fish were relocated throughout the study area at weekly intervals to obtain detailed information on river use (e.g., Missouri vs. Yellowstone) and migrations during pre-spawn, spawn, and post-spawn periods. Bi-weekly tracking was initiated from August through the end of FY 2006. Automated ground-based telemetry logging stations were deployed throughout the study area to provide additional information on movements. In September 2006, transmitters were implanted in an additional 18 shovelnose sturgeon and 19 blue suckers. Telemetry data from the FY 2006 field season will be compiled and analyzed by April 2007.

For research component 3, larval fishes were sampled two times per week between late May and early August 2005 at three sites in the mainstem Missouri River (below Fort Peck Dam, Wolf Point, and Nohly), two tributaries (Milk River, Yellowstone River), and the Fort Peck spillway channel. The sampling regime resulted in 2,073 larval fish samples. Representatives of Catostomidae (suckers) were numerically dominant and composed 59.6% of all larval fish sampled. The Cyprinidae (carps and minnows) comprised 23.7% of the larvae sampled. Hiodontidae (exclusively goldeye, *Hiodon alosoides*), Sciaenidae (exclusively freshwater drum, *Aplodinotus grunniens*) and Percidae (perches) composed 6.2%, 4.7%, and 4.1% of the larvae sampled, respectively. A total of 12 Acipenseridae larvae (0.1% of the total) and 59 paddlefish larvae (0.7% of the larvae) were identified, but an additional 15 larvae (0.2% of the total) could not be confidently distinguished as *Scaphirhynchus sp*. or paddlefish. Six acipenseriform eggs were sampled in addition to nearly 30,000 eggs from other species. Larval fish were sampled in FY 2006 from late-May through early August at the same sites as in earlier years. Expanding on the 2001-2005 data, larval fish data collected during FY 2006 will provide critical information on spawning and hatch dates of *Scaphirhynchus sp.* and other species in the Missouri River, Yellowstone River, Milk River, and off-channel areas. Processing of larval fish samples, larval identification, and results from the FY 2006 larval fish sampling program will be completed by May 2007.

Under research component 4, trawling was conducted between July 19 and September 7, 2005 at four sites in the Missouri River upstream from the Yellowstone River confluence [above the confluence (ATC)], four sites in the Missouri River downstream from the Yellowstone River confluence [below the confluence (BTC)], and four sites in the Yellowstone River. A total of 535 trawls were conducted on eight sampling events. Trawling efforts resulted in a total of 178 young-of-year sturgeon. Eleven young-of-year sturgeon were sampled from the Missouri River ATC, 155 young-of-year sturgeon were sampled from the Missouri River BTC, and 12 young-of-year were collected sampled from the Yellowstone River. Tissue samples from young-of-year sturgeon were collected. The 2005 tissue samples in addition to tissue samples from 2004 were sent to the Service's Abernathy Fish Technology Center for genetic processing. Genetic analyses were conducted to differentiate the young-of-year individuals as pallid sturgeon or shovelnose sturgeon. Furthermore, if individuals were identified as pallid sturgeon, parentage analysis was performed to determine whether the individuals were of hatchery or natural origin. Four individuals sampled in 2004 were genetically identified as pallid sturgeon. Further analysis indicated that these fish were of hatchery origin and were progeny used in the 2004 larval drift study. All young-of-year *Scaphirhynchus* sp. sampled in 2005 were genetically identified as shovelnose sturgeon. In FY 2006, trawling for young-of-year *Scaphirhynchus* sp. was conducted at similar locations and time periods as in previous years. However, only 13 individuals were sampled. Tissue samples from all young-of-year sturgeon sampled during FY 2006 will be sent to the Service's Abernathy Fish Technology Center for genetic processing. As

demonstrated in previous years, trawling is an effective method to sample young-of-year *Scaphirhynchus* sp., obtain critical information on hatch dates, hatch locations, and growth of young *Scaphirhynchus* sp, and quantify inter-annual variations in year class strength. Trawl catch data from FY 2006 will be compiled and analyzed by February 2007.

Under component 5, personnel from MTFWP and USGS assisted in the pallid sturgeon broodstock and propagation program by capturing adult pallid sturgeon in the Missouri River and Yellowstone River. Sampling was conducted during October 2005 and April 2006. Pallid sturgeon sampled were provided to hatchery personnel and reproductive physiology experts to determine sex, reproductive stage, and suitability for the propagation program.

As part of sampling associated with the research components, 36 hatchery-raised juvenile pallid sturgeon (marked individuals) and two unmarked juvenile pallid sturgeon were sampled during FY 2006. Tissue samples from the unmarked individuals will be sent to the Abernathy Fish Technology Center for genetic processing. In addition, genetic results from two unmarked juveniles sampled during 2005 were obtained from Abernathy. Both juveniles were identified as pallid sturgeon. Parentage analysis indicated that these two fish were of hatchery origin, and survivors of larvae released during the 2004 larval drift study.

The final report of activities, analyses, and results of data collected during FY 2006 will be completed by June 2007. Detailed summaries, reports, and publications completed during FY 2006 as part of the Fort Peck Data Collection Plan include: Braaten, P. J., and D. B. Fuller. 2006. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2005 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck. Braaten, P. J., and D. B. Fuller. In Press. Growth rates of young-of-year shovelnose sturgeon in the upper Missouri River. Journal of Applied Ichthyology. Braaten, P. J., D. B. Fuller, and N. D. McClenning. In Press. Diet composition of larval and young-of-year shovelnose sturgeon in the upper Missouri River. Journal of Applied Ichthyology. Braaten, P. J., D. B. Fuller, L. D. Holte, R. D. Lott, W. Viste, T. F. Brandt, and R. G. Legare. In review. Drift dynamics of larval pallid sturgeon and shovelnose sturgeon in natural habitats of the upper Missouri River, Montana.

I.D.4. Physical and Biological Monitoring-Shallow Water Habitat

The Pallid Sturgeon Habitat Assessment and Monitoring Program began in 2004 and has been developed by the Pallid Sturgeon Habitat Assessment and Monitoring Team (Team). The Team is comprised of representatives of State and Federal Agencies and academia that collectively possess responsibility, knowledge and expertise of the Missouri River, pallid sturgeon and native Missouri River fishes, research, experimental design, and statistical analysis. The Team includes the MDC, University of Missouri, USGS, Service, Iowa Department of Natural Resources (IDNR), Nebraska Game and Parks Commission (NGPC), South Dakota Game Fish and Parks, Corps and others.

The program focuses on the endangered pallid sturgeon and a series of native Missouri River species and their habitats as required in the 2000 BiOp and 2003 Amendment.

Objectives of the Program

The monitoring objectives are to assess the (1) physical and (2) biological responses to habitat creation actions.

1) Are physical treatments producing the habitats (quality and quantity) described in the habitat creation documentation being developed?
   a. Hypotheses: There is no physical difference (depth, velocity, substrate) between the constructed site and the control site.
   b. The constructed habitat site has less physical value than the control site

2) Are important fish variables influenced by physical treatments?
   a. Hypotheses: There are no differences in fish species composition, richness, and relative abundance of targeted life stages between the constructed site and the control site.

b. Fish species composition, species richness, and relative abundance of targeted life stages are less at the constructed site than at the control site.

3) Are physical treatments producing change in the overall number of acres of habitat available over time?
Hypotheses: There is no difference in the number of acres of SWH in the lower Missouri River below Sioux City over time. There are less acres of SWH in the lower Missouri River below Sioux City over time.

Program Status Update

Implementation in 2006 was still partial due to uncertainty regarding intensity of sampling within the bend to accomplish our objectives. In the stretch between Sioux City and Rulo, the NGPC sampled 20 bends. In the reach from Rulo to the mouth, the Columbia office of the Service sampled approximately 13 bends.

To remove some uncertainty and better understand what the long-term sampling need for this program is, the field crews sampled a standard number of times within the various macro-habitats within the bend using standard gears. Our standard gears have proven to catch a range of sturgeons with some level of effectiveness, but there is some evidence that these methods are not able to sample all of the habitat diversity available within the bend that we need to sample. To address this issue, there were non-standard gears deployed in both reaches. These gears are exploratory and focused on sampling the unique habitats that are not captured by our standard sampling gears. Gears that prove to be effective at sampling these unique habitats may be considered for inclusion in the standard sampling effort. Supplemental to the standard and non-standard sampling, the Service also conducted an intensive sampling strategy in the lower reach where more developed habitats within the study design exist to provide data for assessing the overall sampling need for the long-term program.

All the data has been collected and is in the process of being entered into the data management system for the pallid sturgeon programs. Once the data is available, analysis of habitat change and biological response will be begin. Analysis will be conducted through the Habitat Assessment and Monitoring Team and through contract.

Independent Review of the program goals and objectives (Phase I) was conducted in 2005. Phase II and III were conducted in 2006. Phase II, review of the technical value of the hydrologic models, was conducted through the H&H Engineering Section of the Corps (Omaha District). The report for that review is available at the site mentioned below. Phase III, review of the models and the biological data together, was completed in October 2006. A report for this effort will also be located at the web site mentioned below.

2006 Summary Reports

The reports for each segment (Rulo and above, Rulo and below), the Independent Scientific Reviews, and any analyses will be available on the web at: http://im4.nwo.usace.army.mil/intro/dms.dmsintro.main listed under “Publications and Reports” after March 31, 2007.

II. LEAST TERN & PIPING PLOVER

II.A. Preparation of a Programmatic Environmental Impact Statement for Emergent Sandbar Habitat (ESH) Creation Activities

Work continues on the Programmatic Environmental Impact Statement (PEIS) for mechanical creation of ESH. David Miller and Associates, the contractor preparing the PEIS, has completed habitat delineation analyses on 1998 and 1999 (Fort Peck reach only) aerial photography as well as 2005 aerial photography. Two Cooperating Agency meetings were held on July 12 and November 13, 2006. A draft PEIS will be available for review in mid winter 2007.

II.B. Emergent Sandbar Habitat Creation Activities

An Indefinite Delivery, Indefinite Quantity (IDIQ) contract was awarded February 27, 2006 to four contractors, L. W. Matteson, Inc., Western Contracting Corporation, Big River Construction Company, and The Dubuque Harbor Tug Service with a five year, forty million dollar capacity. The area of coverage for this IDIQ contract was on the Missouri River from above Gavins Point Dam upstream to Fort Peck Lake. The IDIQ contracting instrument eases the lengthy lead time of a full and open bid process by pre-qualifying a set of contractors and then asking for bids from this set of contractors for each task order. The initial task order on the new IDIQ was awarded to L. W. Matteson, Inc., for creation of a 105 acre emergent sandbar habitat complex in Lewis and Clark Lake. The contractor has until April of 2007 to complete the work. Removal of dead vegetation from 111 acres of interchannel sandbar below Gavins Point, previously sprayed in FY 2005, was accomplished during FY 2006 by Gavins Point hired labor crews.

Vegetation was sprayed by aerial application of herbicide on 123 acres of interchannel sandbars at six sites in the North Dakota portion of Lake Oahe during late summer of FY 2006. A task order was awarded utilizing the IDIQ contract established above Gavins Point in October 2006 to remove the dead vegetation resulting from the herbicide application. The contract will also cover removal of vegetation previously sprayed on 57 acres in the Fort Randall reach as well as 90 acres previously sprayed in the Lewis & Clark Lake. The contract specifies dead vegetation removal will be complete by April 15, 2007.

Lake Oahe sites were chosen based on past usage by the birds and by a joint effort with the State of North Dakota and the Corps under a newly signed Memorandum of Understanding between the two agencies. The Memorandum of Understanding, signed June 27, 2006 states the two agencies will work together to identify Missouri River Recovery projects.

A task order was issued on another IDIQ, which covers projects below Gavins Point, to remove dead vegetation previously sprayed in FY 05 on approximately 316 acres of interchannel sandbar. The sandbars are located from just below Gavins Point to Ponca State Park.

The Yankton Sioux Tribe (YST) received a $250,000 grant from the Service to perform least tern and piping plover habitat work on sandbars adjacent to the Yankton Sioux Reservation. Mr. John Keeler from the YST accompanied representatives from the Corps, the Service, and the National Park Service (NPS) on a river trip below Gavins Point to learn what types of habitat creation projects had been accomplished and to get an idea of how to utilize their grant money. The YST has decided to focus their efforts on mechanical removal of dead vegetation on a sandbar located at river mile 866.6 in the Fort Randall reach of the Missouri River. Approximately 30 acres will be gained by their efforts. The tribe hopes to complete their work so the sandbar will be available for the birds by the spring of 2007.

The Service and the NPS accompanied the Corps on the river below Gavins Point to Ponca state park in early summer to jointly identify FY 2007 ESH projects below Gavins Point. Four sites were identified at RM 791.5, 777.7, 775, and 774. Since the PEIS will not be in place prior to the FY 2007 construction season, work has begun on a site specific Environmental Assessment for the four projects. Design is complete on the projects as well. Work will commence on 15 August 2007.

The NPS, the Service, and the Corps jointly hosted a Mussel Roundtable meeting in Omaha on June 13, 2006. The purpose of the Mussel Roundtable was to discuss Missouri River mussel issues and the discovery of two individual endangered mussel species: the *Leptodea leptodon* (scaleshell) and the *Lampsilis higginsii* (higginsii). Mussel experts from across the country were assembled and decided there may be a potential population of the scaleshell, but thought the potential for a higginsii population was unlikely.

The Corps contracted with Ecological Services, Inc., to perform a comprehensive mussel survey on the Missouri River below Gavins Point after the birds left the area at the end of the 2006 season. Preliminary reports indicate neither endangered species were found. Final report is due by end of December 2006.

The ESH, Kenslers Bend, and Monitoring Product Delivery Teams met in February 2006 and again in November 2006. The ESH PDT discussed and ranked projects for FY 2007. Four projects below Gavins Point will be constructed during FY 2007. The Corps agreed with the National Park Service's suggestion that attempts be made to purchase land adjacent to each ESH complex proposed for FY 2007. If land acquisition cannot happen, attempts will be made to purchase Recreational River Easements or Sloughing Easements. Inability to obtain real estate arrangements will not preclude construction of the four sites. An ESH project suggested by the Nebraska Game and Parks Commission complex near Bazile Creek in Lewis and Clark Lake was also discussed and is being designed. The Bazile Creek project will provide ESH and fish habitat.

Kenslers Bend PDT selected five sites for consideration for top width widening projects with benefits to ESH as well as Missouri River Recovery. After preliminary design, one of the five sites was eliminated from consideration leaving four potential Kenslers Bend sites. Personal contacts will be made with landowners at the four sites to determine if there are any willing sellers. Design on all these projects will continue and will be complete in FY 2007.

The USGS has issued a draft Monitoring Plan for agency review. Changes resulting from input from NPS, Service, and the Corps will be incorporated into the plan and will be ready for implementation by the spring 2007 season.

II.C. Research, Monitoring and Evaluation

Productivity monitoring for least and piping plovers for the 2006 nesting season began on April 12, 2006 with a survey of the Snake Creek Embankment on Lake Sakakawea. Piping plovers were not seen during the survey. Monitoring for the nesting season concluded on August 22, 2006 with final surveys conducted on the Missouri River below Garrison Dam and on Lake Oahe. As a part of the 2006 International Piping Plover Adult Census, the adult census for piping plovers on the Missouri River was conducted two weeks earlier than normal, from June 3 to June 16, 2006. The adult census for least terns was conducted during the normal census window, from June 19 through July 1, 2006

Productivity monitoring and the adult census were conducted on nine of the fifteen Missouri River segments identified by the Service in the 2000 Missouri River Biological Opinion. Segments surveyed were: 1) Segment 1-Fort Peck Lake; 2) Segment 2-the Missouri River from Fort Peck Dam to Lake Sakakawea; 3) Segment 3-Lake Sakakawea (including Lake Audubon); 4) Segment 4-the Missouri River from Garrison Dam to Lake Oahe; 5) Segment 5-Lake Oahe; 6) Segment 7-Lake Francis Case; 7) Segment 8-the Missouri River from Fort Randall Dam to the Niobrara River confluence; 8) Segment 9-Lewis & Clark Lake from the Niobrara River confluence to Snatch Creek; 9) Segment 10-the Missouri River from Gavins Point Dam to Ponca State Park, Nebraska. Segment 6-Lake Sharpe, and Segments 11-15, the Missouri River from Ponca State Park to the confluence with the Mississippi River were not surveyed due to the lack of habitat for either species. Altogether, the nine segments that were surveyed comprise approximately 950 miles of river and reservoirs.

Productivity surveys for least terns and piping plovers began on the following dates for segments on the Missouri River: below Gavins Point Dam – April 26, 2006, Lewis & Clark Lake – May 12, 2006, below Fort Randall Dam – May 12, 2006, Lake Francis Case – June 8, 2006, Lake Oahe – April 29, 2006, below Garrison Dam – May 16, 2006, Lake Sakakawea – April 12, 2006, below Fort Peck Dam – June 8, 2006 and Fort Peck Lake – June 9, 2006.

Training sessions for productivity monitoring and the adult census were held on May 18, 2006 at the Gavins Point Project Office and on May 31, 2006 at the Garrison Project's Riverdale Office. There were 42 attendees at the two sessions including personnel from the Corps, the South Dakota Game, Fish & Parks Department, the Service and the NPS. Training included sessions on the Endangered Species Act (ESA), least tern and piping plover life histories, ESA permit conditions, monitoring techniques, census techniques, data input and global positioning system (GPS) techniques, and instructions on requirements for the International Piping Plover Adult Census.

Data was collected using Trimble Recon data loggers in conjunction with the Trimble GPS equipment. Data collected in the field was then entered into the Threatened and Endangered Species Data Management System (TESDMS). After a quality control check by biologists with the Corps (Omaha District) Threatened and Endangered Species Section, the data was made available on the TESDMS. The TESDMS was accessible by password via the Internet to appropriate federal and state personnel.

Productivity monitoring surveys were conducted on five to ten-day cycles. Nests were found, mapped, and tracked until the eggs hatched or the nest was otherwise terminated. Chicks were tracked from hatching to fledging.

II.C.1 Least Tern Summary

For artificially or mechanically created habitat, the 2003 BiOp Amendment states "[The] wording from the 2000 Biological Opinion is slightly modified to reflect the fact that flow modifications are no longer part of the least tern RPA, fledge ratios are now included in the Incidental Take Statement…" (2003 BiOp, page 197). Page 242 of the 2003 BiOp Amendment states "the Corps should reinitiate consultation if the running 5 year average fledge ratio is less than 0.94." Although this fledge ratio is based on a five year average, page 213 of the 2003 BiOp Amendment states for artificially or mechanically created habitat if "tern and/or plover fledge ratio goals have not been met for the 3-year running average, other means (e.g., creation of habitat) will be necessary to ensure the availability of habitat to meet fledge ratio goals." In 2006, the Corps met the three year running average (2004-2006) for least terns with a fledge ratio of 0.95 fledglings per adult pair (1,151fledglings/1,214 pairs). (See Figure 5 below.)

Photograph 8. Least tern diving for fish on the Missouri River below Fort Peck Dam Montana.

Least Tern Reasonable and Prudent Measure 1 – Survey and Monitor Least Terns, Mortality and Incidental Take

Figure 5. Three-year (2004-2006) Fledge Ratio for Least Terns (Required 0.94)

	Adult Census	Fledged Juveniles	Fledge Ratio
2004	722	344	0.95
2005	904	494	1.09
2006	802	313	0.78
3Yr. Total (2004-2006)	2428	1151	0.95

RPM 1.1 – Annual Least Tern Monitoring Program

Least terns were first observed on the Missouri River on the Gavins Point Segment in mid May. The earliest nest initiation was also on the Gavins Point Segment, occurring on May 19, 2006 on a sandbar at RM 801.1. The latest nest initiation was on the Gavins Point Segment, occurring on July 19, 2006 on a sandbar at RM 797.5. The results of the 2006 adult census and monitoring efforts for the least tern can be found in the table below (Figure 6).

Figure 6.
Result of 2006 Adult Census and Monitoring Efforts of the Interior Least Tern on the Missouri River

	Adult Census	**Nests**	**Broods**	**Nests Hatched**	**% Nest Success (a)**	**Total Chicks Fledged**	**Fledge Ratio (b)**
Segment 1 - Fort Peck Lake	2	1	0	1	100.0	3	3.00
Segment 2 - Missouri River Below Fort Peck Dam	36	21	0	14	66.7	21	1.17
Segment 3 -Lake Sakakawea	48	30	0	21	70.0	17	0.71
Segment 4 - Missouri River below Garrison Dam	139	79	2	47	59.5	56	0.81
Segment 5 – Lake Oaheam	128	97	0	57	58.8	73	1.14
Segment 7 -Lake Francis Case	11	6	0	2	33.3	3	0.55
Segment 8 - Missouri River below Fort Randall Dam	55	45	0	25	55.6	19	0.69
Segment 9 -Lewis and Clark Lake	0	0	0	0	0	0	0.00
Segment 10 - Missouri River below Gavins Point Dam	383	322	3	167	51.9	121	0.63
Total	**802**	**601**	**5**	**334**	**55.6**	**313**	**0.78**

Percent Nest Success = HN/N*100, where HN= hatched nests and N=number of nests
Fledge Ratio = number of fledged chicks per pair of adult birds

There were 802 least tern adults counted on the Missouri River in 2006. This is the second highest number ever recorded for the river since the census began in 1986. This is the fifth consecutive year adult numbers were above 700. The 802 adults, however, represent an 11.3% decline compared to the all-time record high 2005 adult census of 904 least terns. The 802 adults in 2006 marks the second consecutive year since the publication of the 1988 interior least tern recovery plan that the Missouri River recovery goal of 800 adults has been exceeded. (See chart below.)

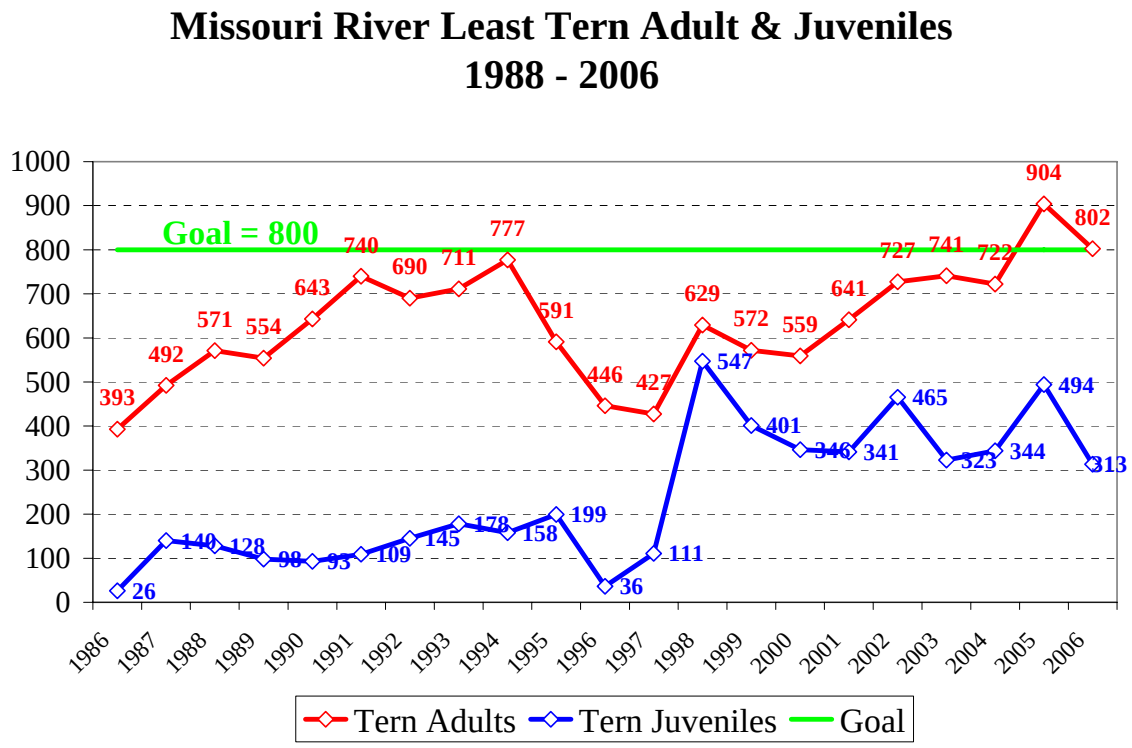


Figure 7. Missouri River Least Tern Adult and Juveniles (1988-2006).

The chart below (Figure 8) below shows the adult tern distribution by segments. The segments have been color coded with green shades representing riverine segments and blue shades representing reservoir segments. Due to low lake levels, the upper part of Lake Oahe is more riverine in nature than reservoir. Therefore, Lake Oahe has been divided into Lake Oahe River and Lake Oahe. The chart shows that the tern adults preferred the river segments with 82.7% (663/802) of the adults found on those segments.

The chart shows that least tern adults continue to concentrate on the 59 miles long Gavins Point Segment. In 2006, 47.8% (383/802) of the terns on the Missouri were found on this segment. This continues a trend from past years when 52.7% (476/904) of the terns in 2005, 49.7% (359/722) of the terns in 2004, and 49.4% (366/741) of the terns in 2003 were found on the Gavins Point Segment. The Figure below (Figure 8) compares least tern adult numbers by segment for 2005 and 2006.

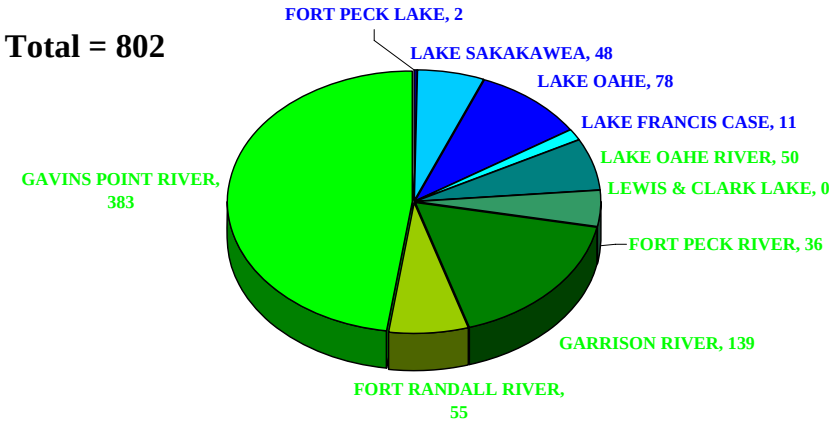


Figure 8. 2006 Missouri River Least Tern Adults by Segment

Figure 9.
Least Tern Adults by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	0	2	+2	-
Fort Peck River	34	36	+2	+6
Lake Sakakawea	26	48	+22	+85
Garrison River	155	139	-16	-10
Lake Oahe	133	128	-5	-4
Lake Francis Case	0	11	+11	-
Fort Randall River	76	55	-21	-28
Lewis & Clark Lake	4	0	-4	-
Gavins Point River	476	383	-93	-20
Total	**904**	**802**	**-102**	**-11**

For the first time in three years, least terns were found on Fort Peck Lake. Lake Sakakawea set an all-time record with 48 terns counted. However, least tern numbers were down on four of the segments. The largest decline occurred on the Gavins Point Segment with a loss of 93 adults. Refer to RPM 4 for more discussion of this decline on the Gavins Point Segment (page 33). By percentage, the Fort Randall Segment saw the largest decline, with the Garrison and Lake Oahe Segments showing minor declines.

Productivity declined for least terns in 2006 with 313 fledglings. This represents a 36.6% decrease from 2005's 494 fledglings. The pie chart below shows the fledgling distribution by segment. As with the adults, green shades indicate river segments and blue shades indicate reservoir segments and Lake Oahe has been divided into river and reservoir sections.

2006 Missouri River Least Tern Fledglings by Segment

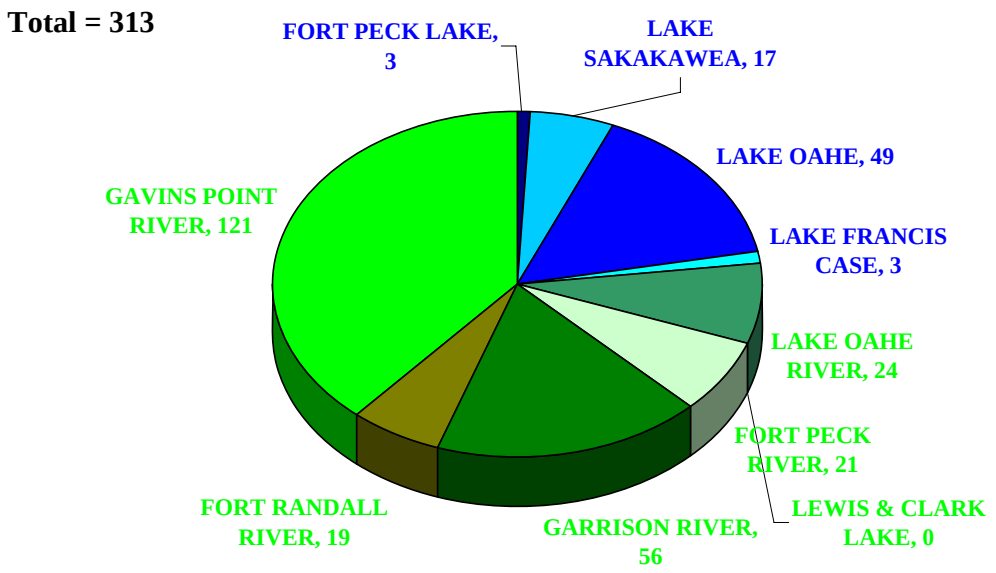


Figure 10. 2006 Missouri River Least Tern Fledgling by Segment

As would be expected, the highest number of fledglings was found on the Gavins Point Segment. The adults on Gavins Point accounted for nearly 48% of all adults on the Missouri. This segment accounted for only 38.7% of all fledglings. This discrepancy is further discussed in RPM 4 (page 33). The pie chart (figure 10) shows that substantial numbers of tern fledglings were also found on the Garrison and Lake Oahe Segments. The table below (Figure 11) compares least tern fledgling numbers by segment for 2005 and 2006.

Figure 11. Least Tern Fledglings by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	0	3	+3	-
Fort Peck River	37	21	-16	-43
Lake Sakakawea	4	17	+13	+325
Garrison River	55	56	+1	+2
Lake Oahe	59	73	+14	+24
Lake Francis Case	3	3	0	0
Fort Randall River	18	19	+1	+6
Lewis & Clark Lake	0	0	0	0
Gavins Point River	318	121	-197	-62

By numbers, in 2006, five segments saw increases in least tern fledgling numbers, two saw no change, and two saw declines. Least terns were fledged off of Fort Peck Lake for the first time since 2000 and Lake Sakakawea set an all-time high for fledglings. There was also a significant percentage increase in tern fledglings on Lake Oahe. However, there was a significant decrease in tern fledglings on the Fort Peck River Segment. This decline was minor in both numbers and percent of decline compared to the Gavins Point Segment. Refer to RPM 4 for a fuller discussion of this decline on the Gavins Point Segment (page 33).

The overall fledge ratio for least terns on the Missouri River was 0.78 fledglings per adult pair in 2006. This was a decline compared to the 2005 fledge ratio of 1.09 and marked a reversal of a two year upward trend in the annual fledge ratio. The 2006 fledge ratio marks a return to an overall downward trends and marks the lowest fledge ratio since the high water year of 1997. The chart below (Figure 12) shows an annual comparison of fledge ratios for least terns on the Missouri River from 1986 through 2006.

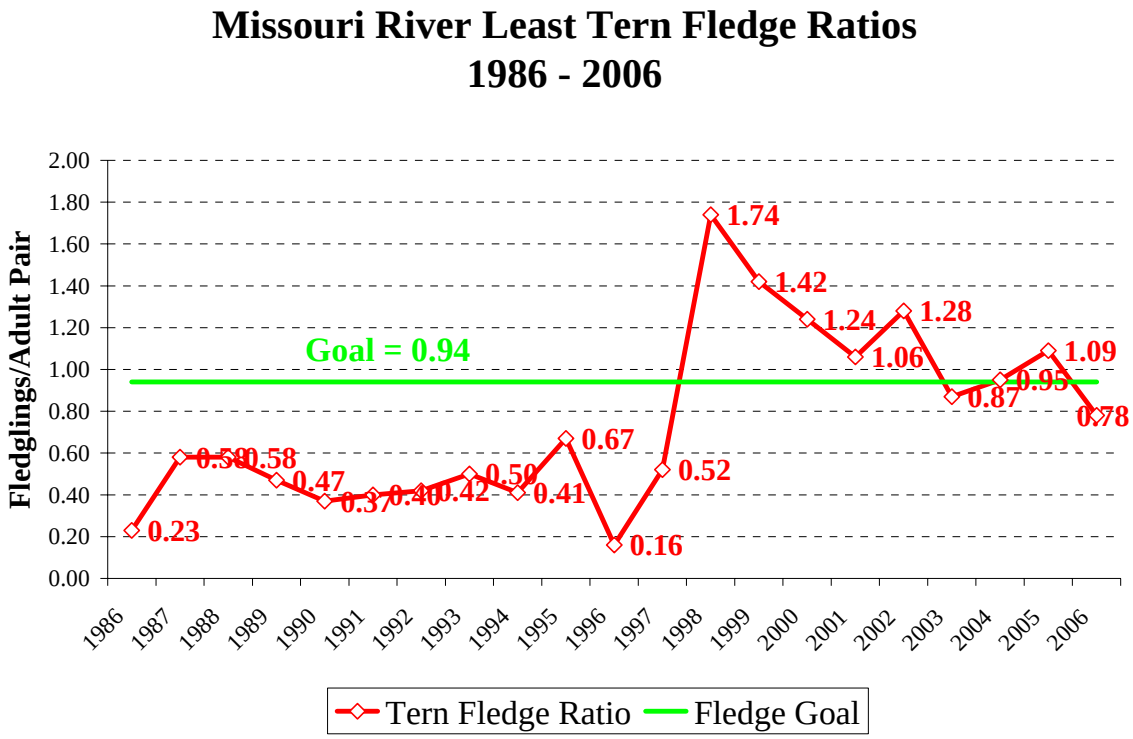


Figure 12. Missouri River Least Tern Fledge Ratios (1986-2006)

The above chart is for annual comparisons only. For BiOp compliance, the measure is a three year running average for habitat and a five year running average for incidental take. As stated earlier, the three year running average for 2004-2006 was 0.95 fledglings per adult pair and the five year running fledge ratio average for 2002-2006 was 1.00 fledglings per adult pair. The five year running average will be more thoroughly discussed in the Incidental Take section. Figure 13 below compares least tern adult fledge ratio by segment for 2005 and 2006.

Figure 13.
Least Tern Fledglings by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	0.00	3.00	+3.00	-
Fort Peck River	2.18	1.17	-1.01	-54
Lake Sakakawea	0.31	0.71	+0.41	+129
Garrison River	0.71	0.81	+0.10	+14
Lake Oahe	0.89	1.14	+0.25	+28
Lake Francis Case	0.00	0.55	+0.55	-
Fort Randall River	0.47	0.69	+0.22	+47
Lewis & Clark Lake	0.00	0.00	0.00	0
Gavins Point River	1.34	0.63	-0.71	-53

In 2006, fledge ratios were up on six of the segments, down on two, and unchanged on one. The fledge ratio goal of 0.94 was surpassed on three of the nine segments: Fort Peck Lake, Fort Peck River, and Lake Oahe. There was a large decline in the fledge ratio on the Gavins Point Segment. With a high proportion of the least terns on the Missouri River using the Gavins Point Segment, the success or failure of the least tern on the Missouri River is more and more being borne by the productivity on the 59 miles of the river along this segment.

RPM 1.2 – Mortality of Adults, Chicks, Eggs and Nests

Nest Mortality: In 2006, there were 601 least tern nests on the Missouri River, second most ever to 2005's record 649 nests. Of these nests, 334 were successful (at least one egg hatched from the nest). In addition to these successful nests, there were five least tern broods that were found that could not be associated with any previously known nest.

For the 267 non-successful nests, the nest fates are as follows: 1) Flooded (Non-Corps Operations) – 2 nests: These nests were lost to rising river levels as a result of rain storms in the area (see Incidental Take section); 2) Flooded (Corps Operations) – 7 nests: These nests were lost due to the Corps operation of the Missouri River dams (see Incidental Take section); 3) Weather – 54: These are nests lost to weather events such as rain, hail, and wind; 4) Predation – 41: Predators include mink, raccoons, coyotes, owls, gulls, crows, and other mammal and avian species; 5) Livestock – 1: This nest was destroyed by livestock stepping on it; 6) Wildlife – 3: These nests were destroyed by Canada geese stepping on the nests; 7) Human Disturbance – 2: These nests were lost to human activity; 8) Destroyed, No Evidence – 46: These were nests that were destroyed before the eggs could have hatched, but for which no cause could be determined by the survey crew; 9) Fate Undetermined – 83: These are nests where the egg incubation was far enough along whereby the eggs could have hatched between site visits. However, the crew could find neither evidence of egg hatching nor evidence that the nest had been destroyed prior to the subsequent nest visit; 10) Abandoned – 27: These are nests that were abandoned by the adults; 11) Non-viable Eggs – 1: This was a nest in which the eggs were not viable, but were still incubated by the adults.

Adult and Chick Mortality: Survey crews were instructed to try and determine a cause of death for least tern adults and chicks found on site. If a cause of death could not be determined and the specimen was fresh (little to no decomposition), the specimen was then sent to the National Wildlife Health Center (NWHC) in Madison, Wisconsin for analysis. Four adult, one fledgling, and five chick specimens were found in 2006.

The results for the least tern specimens (adults) are as follows: 1) Lake Sakakawea Segment: The specimen was found on the east shore of the Van Hook Arm south of Parshall Bay on August 8, 2006. The specimen was too decomposed to determine a cause of death; 2) Garrison River Segment: The specimen

was found on July 24, 2006 on a sandbar at RM 1308.5. The specimen was sent to the NWHC for necropsy. The results are pending. 3) Gavins Point Segment: (a) The specimen was found on June 22, 2006 on a created sandbar at RM 770.0. The specimen was sent to the NWHC for necropsy. The necropsy determined the cause of death to be attributed to the West Nile virus; (b) The specimen was found on July 5, 2006 on a sandbar at RM 789.6. The specimen was too decomposed to determine a cause of death.

The results for the least tern specimen (fledgling) is as follows: 1) Fort Randall Segment: The specimen was found on August 7, 2006 at RM 854.0. The specimen was too decomposed to determine a cause of death.

The results for the least tern specimens (chicks) are as follows: 1) Gavins Point Segment: (a) The one-three days old chick was found dead in the nest bowl on June 27, 2006 at the created sandbar complex at RM 761.3. It was too decomposed to collect for necropsy. (b) The 6-10 days old chick was found on July 27, 2006 at RM 804.6. The chick had been stepped on by a Canada goose. See the Incidental Take section for further information (page 32). (c) The 18-20 days old chick was found lying on its side on July 27, 2006 at RM 804.6. The chick was alive, but in a weakened condition when it was first observed in the morning. When the crew returned in the afternoon, they found the chick had died. The chick was collected and sent to the NWHC for necropsy. The results showed water in the lungs indicating possible drowning and the bird tested positive for West Nile virus. (d) Two 10 day old brood mates were found dead on August 4, 2006 at RM 781.4. This small sandbar had been built up to prevent inundation from increased releases out of Gavins Point Dam and, therefore, the chicks had been closely monitored. On the previous site visit on July 31, the two chicks appeared to be normal. The chicks' remains were sent to the NWHC for necropsy. The lab determined that both chicks died from the West Nile virus. The virus was found in the pin feathers, brains, spleens, and kidneys of the two chicks.

Photograph 9. Least tern chicks that succumbed to the West Nile virus
(Note, one chick was a partial albino)

Where the cause of death could be determined for least tern losses, four died from the West Nile virus and one was stepped on by a Canada goose. No tern chicks were killed by being stepped on by a human, whereas, this was recorded four times in 2005.

Mortality caused by Corps of Engineers Operations

The 2003 Biological Opinion Amendment incidental take statement set a five year running average fledge ratio goal of 0.94 fledglings per adult pair to be maintained by the Corps of Engineers. Figure 14 below shows the Corps has exceeded the five-year (2002-2006) fledge ratio 0.94 for least terns with a five-year fledge ratio of 1.00 fledglings per adult pair. The chart below (Figure 15) shows the five year running average for the Missouri River from 1986-1990 through 2002-2006.

Figure 14.
Five-Year (2002-2006) Fledge Ratio for Least Terns (Required: 0.94)

Year	Adult Census	Fledged Juveniles	Fledge Ratio
2002	727	465	1.28
2003	741	323	0.87
2004	722	344	0.95
2005	904	494	1.09
2006	802	313	0.78
5 Yr. Total (2002-2006)	**3896**	**1939**	**1.00**

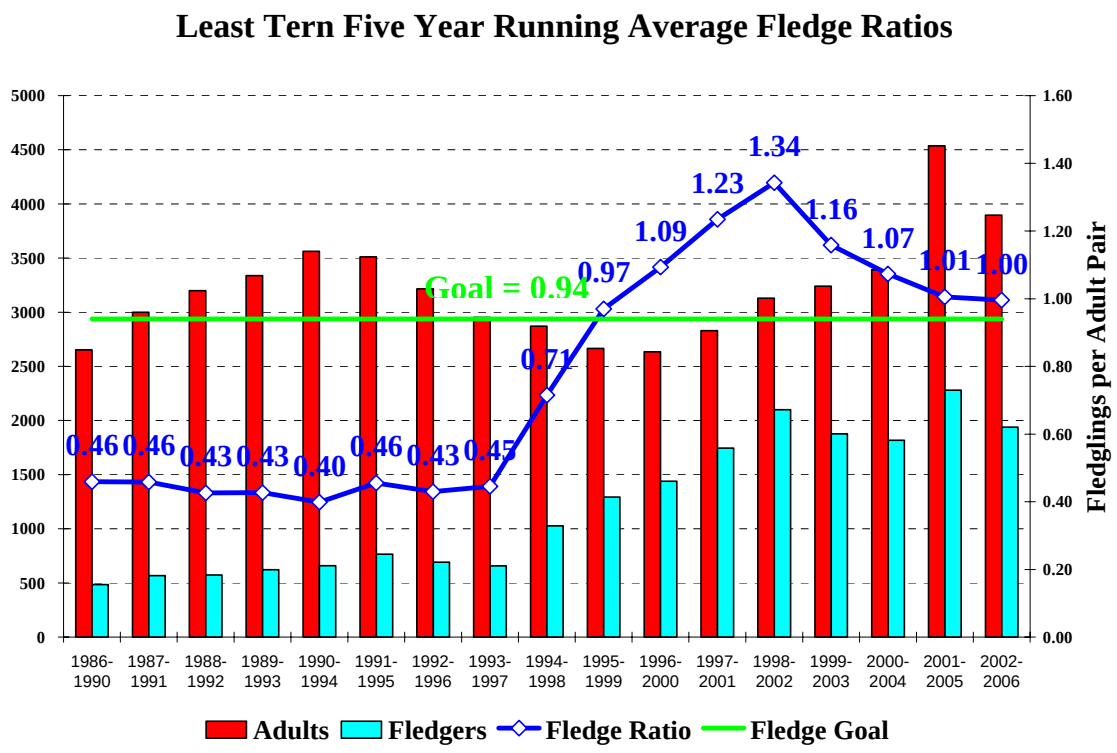


Figure 15. Least Tern Five Year Running Average Fledge Ratios.

The chart shows that the Corps has maintained the five year running average above 0.94 fledglings per adult pair for eight consecutive years. However, there has been a downward trend for the past four years. The 2003 BiOp amendment states that "re-initiation of consultation will be required if the Corps' actions will result in take of more than 180 eggs in a 3-year consecutive period." In 2006, seven tern nests containing twelve eggs and two tern chicks were lost to Corps operations. In 2004, no tern eggs were taken and, in 2005, nine tern eggs were lost due to Corps operations. The three year take due to Corps operations (2004-2006) of 23 tern eggs and chicks is well below the re-consultation trigger of 180 eggs.

Incidental Take Statement

In 2006, incidental take due to Corps operations totaled twelve least tern eggs and two chicks. The losses came from seven nests; one from the Garrison River Segment, one from Lake Francis Case and five from the Gavins Point River Segment. The two chicks were lost on the Gavins Point River Segment.

Garrison River: A one egg least tern nest (Nest ID 064218) was located on a sandbar at RM 1345.0 on June 5, 2006. The nest was listed as at risk by the survey crew. On the next site visit on June 27, the nest site was under water. The nest loss was attributed to a June 8, 2006 increase in releases from 19,000 cfs to 21,000 cfs out of Garrison Dam.

Lake Francis Case Segment: On June 19, 2006 a two-egg tern nest with three days incubation was found at North Point. The crew determined the nest to be at risk. On the next site visit on June 26 the crew found the nest destroyed with flood debris around the nest. On June 19, the elevation of Lake Francis Case was recorded at 1354.2 feet mean sea level (msl). The lake peaked at 1355.2 feet on June 23, and was at 1354.9 on June 26. Corps operations took the nest.

Gavins Point River Segment: On July 21, 2006 water releases from Gavins Point Dam were 25,500 cfs. Over the next ten days (to July 31, 2006), releases were increased to 31,000 cfs to meet flow targets in the navigation channel on the lower Missouri River. This action led to the loss of five tern nests with nine eggs and two tern chicks. The losses are described as follows:

RM 804.6: One 6-10 day old tern chick was found dead on July 28, 2006. The chick was flattened and it is believed the chick was stepped on by a Canada goose. The chick was found at the site where a tern nest had been raised to prevent its loss to inundation. The sandbar had been inundated except for this site and another area where a tern nest was raised. Canada geese had congregated on the site.

RM 797.5: A one-egg tern nest (0610530) was found on July 20, moved and raised on July 21, and found under water on July 27.

A two-egg tern nest (0610513) was found on July 12 and was moved and raised on July 21. The nest was above water on the site visit of July 27, but was found under water on July 31 after releases were raised from 30,000 to 31,000 cfs.

A three-egg tern nest (0610528) was found on July 20 and was moved and raised on July 21. The nest was above water on the site visit of July 27 and was raised again, but was found under water on July 31 after releases were raised from 30,000 to 31,000 cfs.

A two-egg tern nest (0610529) was found on July 20 and was moved and raised on July 21. The nest was above water on the site visit of July 27 and was raised again, but was found under water on July 31 after releases were raised from 30,000 to 31,000 cfs.

RM 797.3: The sandbar at this location was built up with tires and logs to provide a platform for a tern chick that hatched out on July 21. The site was inundated when checked on July 31. Loss was due to increased releases from Gavins Point Dam from 30,000 to 31,000 cfs.

RM 781.4: A two-egg tern nest (0610503) was raised on July 21, 2006 to prevent its loss from inundation due to increased releases out of Gavins Point Dam. The nest was checked on July 24 and found with one

egg missing and one egg considered still viable. The nest was again checked on July 27. The one egg present at the previous visit was found smashed in the nest bowl with goose foot prints all over the raised mound. The loss was considered incidental take as the increased releases out of Gavins Point Dam caused the geese to congregate on the raised mound.

During the 2006 nesting season, two other least tern nests were lost to flooding. These flood losses were not caused by Corps operations and are described as follows. A three-egg tern nest (0610243) and a one-egg tern nest (0610244) were found on a sandbar at RM 802.5 on June 7, 2006. Releases from Gavins Point Dam on this date were 25,000 cfs. Both nests were found under water on the next site visit on June 16, 2006. Releases from Gavins Point Dam on this date were 25,000 cfs. Between June 7 and June 16, releases from Gavins Point Dam varied from 23,000 to 25,000 cfs. Because releases from Gavins Point Dam were never higher than the 25,000 cfs when the nests were found on June 7, some other non-operation cause was responsible for inundating the nests.

Corps Operations to Minimize Take

Throughout the nesting season, the Corps Water Management Division and its Threatened and Endangered Species Section held conference calls on Monday, Wednesday, and Friday to discuss water releases from the Missouri River dams and their effects on least terns and piping plovers. These discussions were used to minimize take by communicating water release schedules relative to nests and sandbars that have been identified as "at risk" due to Corps operations. In July 2006, water was released from Corps dams on Kansas River tributaries to supply water to meet the navigation target at Kansas City, Missouri rather than to increase releases out of Gavins Point Dam. This delayed increase out of Gavins Point Dam to support navigation until July 21. Throughout the nesting season, hydropower peaking controls are in place for Fort Randall and Garrison Dams to minimize take of eggs and birds on the Missouri below these two dams.

RPM 4 – Monitor, Evaluate, and Modify Created and Rehabilitated Sandbars.

The Corps of Engineers has undertaken several projects to create and rehabilitate sandbars for least tern use. In 2004, a sandbar complex was built between RM 755.0 and 754.5. This was followed by the construction of sandbar complexes at RM 770.0 and 761.3 during the fall of 2004 and early spring of 2005. In the fall of 2004, 135 acres of sandbars below Gavins Point dam were treated with herbicide to remove vegetation. In the spring of 2005, some sandbars were mowed to remove the dead plant material. In the fall of 2005, 650 acres of sandbars in the Fort Randall, Lewis & Clark Lake, and Gavins Point Segments were rehabilitated by herbicide application to remove vegetation. In the spring of 2006, some sandbars were mowed to remove the dead plant material. The following is an explanation of habitat types found on the Fort Randall, Lewis & Clark Lake, and Gavins Point Segments, a summary of 2006 adult census, nest numbers, nest success and productivity between different habitat types on the three segments, and a comparison between 2005 and 2006 results by habitat types.

Gavins Point River Segment Habitat Types:

1. Created: This is habitat constructed by the Corps. This includes the sandbars at RM 770.2, 770.1, 770.0, 761.3, 755.0, and 754.5.

2. Low Releases: In 2005, releases from Gavins Point Dam averaged around 21,500 cfs for most of the summer. These low releases exposed sandbars that previously were never available to the birds for nesting. In 2006, releases were higher out of Gavins Point Dam, averaging around 25,000 cfs, until the third week in July when releases were gradually increased to 31,500 cfs by August 2, 2006 to support navigation. Generally, the low sandbars that were available in 2005 persisted in 2006, though they were smaller in size due to the higher releases and they had more vegetation than in 2005. Sandbars in this category occurred at RM 808.2, 807.3, 804.6, 802.1, 797.3, 795.5, 791.5, 781.4, 777.5, and 774.0.

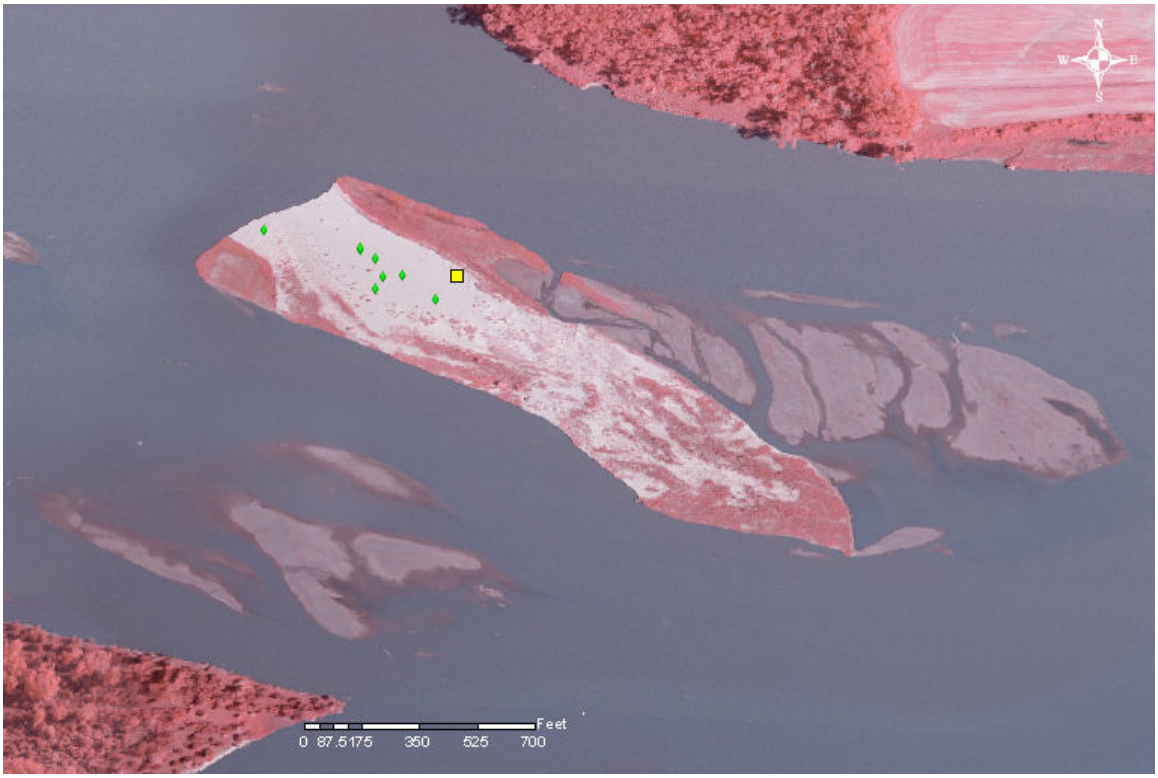
3. Sprayed and Mowed: These are sandbars that were sprayed with herbicide either in 2004 or 2005 and then were mowed in 2005 or 2006 to remove the dead plant material. Sandbars sprayed in 2004 and mowed in 2005 include those at RM 781.5. Sandbars sprayed in 2004 and mowed in 2005 and 2006

include those at RM 756.6. Sandbars sprayed in 2005 and mowed in 2006 include those at RM 801.1 (a portion), 757.2, and 756.8.

4. Sprayed and Mowed (Natural): A sandbar at RM 759.2 was sprayed in the fall of 2005 and then mowed in the spring of 2006. There was one tern nest on the site, but the nest was located in an area that was not sprayed and mowed.

5. Sprayed: These are sandbars that were sprayed with herbicide in either the fall of 2004 or 2005, but where the dead plant material was not removed by mowing. One sandbar sprayed in 2004 was located at RM 777.7. Sandbars sprayed in 2005 include those found at RM 801.1 (a portion), 799.0, 796.7, 796.3, 795.3, 793.6, 793.3, 790.9, 790.0, 786.1, 785.2, 784.5, 783.0, 778.5, 777.7, 773.0, 768.0, and 759.5.

6. Sprayed (Natural): These were sandbars that were sprayed but the terns nested in areas that were not sprayed. Terns nested along the shoreline of the sandbars at RM 797.5 and 789.6. Terns nested in an area at RM 782.5 (see Photograph 10 below) that was free of vegetation in 2005 and, therefore, did not receive any treatment.



Photograph 10. 2006 Least Tern Nests (Green Diamonds) & Piping Plover Nest (Yellow Square) at RM 782.5 (2005 imagery)

7. Natural: These are sandbars that currently or since 1998 have had bird (tern and/or plover) nesting and where no management activity such as spraying and/or mowing has occurred. These sandbars include sites at RM 807.6 (shoreline), 807.3, 804.5, 803.4, 802.5, 801.3, 788.5, 777.0, 775.2, 764.5 and 760.0. Note that sandbars that had nesting activity, but no longer exist, are not included.)

Lewis & Clark Lake Habitat Types

1. Sprayed: These are sandbars were sprayed with herbicide in either the fall of 2004 or 2005, but where the dead plant material was not removed by mowing. Sandbars sprayed in 2004 were RM 842.2 and 838.0

(a portion). Sandbars sprayed in 2005 were RM 839.5, 839.0, 838.0 (a portion), and 837.0.

2. Natural (defined above): RM 843.3, 842.6, 841.9, 840.0, 838.6, 836.0, 834.3, 832.2, 830.3, 828.4, and 827.0.

Habitat Types – Fort Randall River

1. Sprayed: These are sandbars that were sprayed with herbicide in 2005, but the dead plant material was not removed by mowing. Sandbars sprayed were located at RM 870.2, 869.5 (a portion), 866.9, 866.5, 863.7, 854.7, 854.0, 851.6, 848.0, 847.2, and 847.1.

2. Natural (defined above): RM 875.0, 869.5 (a portion), 855.5, and 853.4.

Nest Success by Habitat Type on the Gavins Point Segment in 2006

Figure 16 shows the habitat type, the number of nests, the number of successful nests, the number of nests that were not successful, the number of nests in which the fate was not determined, the percent successful nests for the habitat type, and the percent of nests in the habitat type to the total number of nests in the segment. Successful is defined as a nest in which at least one egg hatched; not successful is defined as a nest that was destroyed (flooding, weather, predation, etc.) or was abandoned; not determined is defined as a nest in which the egg incubation was far enough along so that the eggs could have hatched between site visits, but the crew could find no evidence of egg hatching or nest destruction on the subsequent nest visit.

Figure 16. Least Tern Nest Success by Habitat Type – Gavins Point Segment 2006

Habitat Type	**Total**	**Successful**	**Not Successful**	**Not Determined**	**% Successful**	**% of Total Nests**
Created	194	116	56	22	59.8	60.2
Low Releases	40	14	19	7	35.0	12.4
Natural	26	9	16	1	34.6	8.1
Spray	29	12	13	4	41.4	9.0
Spray (Natural)	19	10	8	1	52.6	5.9
Spray & Mow	13	6	7	0	46.2	4.0
Spray and Mow (Natural)	1	0	1	0	0.0	0.3
Total	**322**	**167**	**120**	**35**	**51.9**	**100.0**

The figure shows the created sites had the majority of the nests (60.2%) on the Gavins Point Segment. If one considered the natural sites, the nests that were in natural areas of spray sites, and the nests that were in natural areas of the spray and mowed site as the same habitat type, then these combined natural categories had the second highest number of nests at 14.2% (46/322). The low releases sites had the next highest number of nests with just under one-eighth (12.4%) of all nests. The spray sites made up 9.0% of all the nests and the spray and mow sites had 4.0% of the nests.

The created sites also had the highest nest success of the habitat types with a nearly 60% success rate. In contrast to the created sites, none of the other habitat sites had a nest success above 50% with the combined natural sites having a success rate of 41.3% (19/46).

The Figure below (Figure 17) compares total number of nests, successful nests, and nest success by habitat type between 2005 and 2006.

Figure 17.
Least Tern Nest Success by Habitat Type – Gavins Point Segment 2005-2006

Habitat Type	2005 Total Nests	2005 Successful Nests	2005 % Successful	2006 Total Nests	2006 Successful Nests	2006 % Successful
Created	159	103	64.8	194	116	59.8
Low Releases	71	35	49.3	40	14	35.0
Natural	90	32	35.6	46	19	41.3
Spray	0	0	0.0	29	12	41.4
Spray and Mow	32	23	71.9	13	6	46.2
Total	**352**	**193**	**54.8**	**322**	**167**	**51.9**

Figure 17 shows that the number of nests and successful nests on the created sites increased in 2006 compared to 2005, but the nest success was slightly lower. For the low releases sites, the number of nests, successful nests, and nest success were all down in 2006 compared to 2005. This is likely due to the fact that the low releases sites were much smaller in 2006 due to higher releases out of Gavins Point Dam. The natural sites' number of nests and successful nests were lower, but the nest success was higher in 2006 compared to 2005. The increase in nests on spray sites between 2005 and 2006 is likely due to the increase in spray sites. In 2005, there was just one spray site and the terns did not use it. In 2006, there were several formerly natural sites that were now spray sites (Figure 18). For the spray and mow sites in 2006, the number of nests, successful nests, and nest success all dropped dramatically compared to 2005. This was due primarily to the terns' abandonment of the sandbar at RM 781.5 (30 nests, 22 successful in 2005, 0 nests in 2006).

It is important to determine if the rehabilitation measures (spray, spray and mowing) work. Figure 17 examines tern nest use on sandbars that had spray and mow work performed on them prior to the 2006 nesting season. The "Years Used by Terns" column shows the years the site had at least one tern nest. The "#Nests/#Successful" column shows the number of tern nests and the number of successful nests the last year the site was used by the terns. For example, at RM 781.5 there were 30 nests and 22 were successful in 2005.

Figure 18. Least Tern Nests Natural vs. Spray and Mow

	Natural		Spray and Mow	
River Mile	**Years Used by Terns**	**#Nests/# Successful**	**Year Work Performed**	**2006 Use Nests/Hatched**
801.1 (a portion)	Never	0/0	2006	12/5
781.5	1998-2005	30/22	2005	0/0
759.2	2002-2004	4/4	2006	0/0
757.2	Never	0/0	2006	0/0
756.8	2002	1/1	2006	0/0
756.6	1999-2000, 2002-2005	2/1	2005	1/1

On these sites, the terns developed a colony at RM 801.1, a site they had previously never used. This gain was offset by the abandonment of RM 781.5, which was a major and successful colony site in 2005. Only one of the four other spray and mow sites was used in 2006, RM 756.6, and it had but one nest.

Figure 19 examines tern nest use on sandbars that had spray work performed on them prior to the 2006 nesting season. The "Years Used by Terns" column shows the years the site had at least one tern nest while the "#Nests/#Successful" column shows the number of tern nests and the number of successful nests the last year the site was used by the terns. For example, at RM 799.0, there was one nest and it was successful in 2001.

Figure 19. Least Tern Nests Natural vs. Spray

	Natural		**Spray**	
River Mile	**Year Last Used by Terns**	**#Nests/# Successful**	**Year Work Performed**	**2006 Use Nests/Hatched**
801.1 (a portion)	Never	-	2006	0/0
799.0	2001	1/1	2006	0/0
797.5	2005	6/6	2006	0/0
796.7	Never	-	2006	0/0
796.3	Never	-	2006	0/0
795.3	2005	8/5	2006	19/10
793.6	2005	1/1	2006	1/1
793.3	2005	6/4	2006	8/0
790.1	Never	-	2006	0/0
790.0	Never	-	2006	0/0
789.6	2005	3/2	2006	0/0
786.1	Never	-	2006	0/0
785.2	Never	-	2006	0/0
784.5	Never	-	2006	0/0
783.0	Never	-	2006	0/0
782.5	2003	1/1	2006	0/0
778.5	2004	16/8	2006	1/1
777.7	2003	4/4	2005	0/0
773.0	2001	1/1	2006	0/0
768.0	2004	7/1	2006	0/0
759.5	Never	-	2006	0/0

Of the 21 sites that were sprayed (20 in 2006 and 1 in 2005) and that were not mowed, the results for 2006 varied. Eleven of the sprayed sites had never been previously used by the terns and the spraying of these sites did not cause the terns to use the sandbars in 2006. Of the four sites used by the terns in 2006, three were used by the terns in 2005 and the fourth was used by the terns in 2004. In the three 2005 cases, there was a marked improvement in the number of nests and successful nests at RM 795.3; RM 793.6 stayed the same with one successful nest; and, though RM 793.3 had more nests in 2006 than in 2005, none were successful. For RM 778.5, the large drop off of tern nests in 2004 and no nests in 2005 was probably due to erosion that greatly reduced the size of the sandbar rather than vegetation encroachment.

Terns nested on three sprayed sandbars, but did not nest in areas that were sprayed. These results are displayed in the following table (Figure 20).

Figure 20. Tern Nesting in Non-Spray Areas of Spray Sandbars

River Mile	Years Used by Terns	#Nests/# Successful	Year Work Performed	2006 Use Nests/Hatched
797.5	2005	6/6	2006	5/1
789.6	2003-2005	3/2	2006	6/3
782.5	2003	1/1	2006	8/6

For RM 797.5, in 2005, the terns nested on the far eastern end of the sandbar where quality habitat was exposed by the low releases from Gavins Point Dam. In 2006, the terns nested on the shoreline areas on the north side of the sandbar and not in the sprayed area. At RM 789.6, terns returning from 2005 may have again nested on the sandbar, but they used the shoreline areas and not the sprayed area. At RM 782.5, terns returned to the sandbar for the first time in three years, but they nested in an area that was free of vegetation in 2005 and did not nest in the sprayed area. Whether the spayed area made the already vegetation free area more attractive to the terns or whether lack of habitat elsewhere caused the terns to return is not known.

Nest numbers and nest success are not the only way to measure least tern use of created and rehabilitated habitat. Adult numbers, fledglings, and fledge ratios measure the productivity of the birds on the sandbars. Figure 21 shows the 2006 results by habitat type below Gavins Point.

Figure 21. 2006 Gavins Point Segment Least Tern Success by Habitat Type

Habitat Type	Adults	Fledglings	Fledge Ratio
Created	254	83	0.65
Low Releases	41	15	0.73
Natural	22	3	0.27
Spray	50	19	0.76
Spray and Mow	16	1	0.13
Total	383	121	0.63

Figure 21 shows that the created sites had most of both adults (66.3%) and the fledglings (68.6%). The spray sites and low releases sites came in second and third, respectively, for the adults and fledglings. None of the habitat types met the fledge ratio goal of 0.94% fledglings per adult pair with the spray sites doing the best at 0.76%. The 2005 results are shown in the Figure below (Figure 22). Figure 22 compares the numerical and percent increase or decrease between 2005 and 2006 by habitat type.

Figure 22. 2005 Gavins Point Least Tern success by Habitat Type

Habitat Type	Adults	Fledglings	Fledge Ratio
Created	206	181	1.76
Low Releases	98	61	1.24
Natural	116	43	0.74
Spray	0	0	0.00
Spray and Mow	56	33	1.18
Total	476	318	1.34

Figure 23. Tern Adults, Fledglings & Fledge Ratios by Habitat, Gavins Point Segment 2005-2006

Habitat Type	Number of Adults 2005-2006	% Adults 2005-2006	Number of Fledglings 2005-2006	% Fledglings 2005-2006	Fledge Ratio Difference 2005-2006
Created	+48	+23.3	-98	-54.1	-1.11
Low Releases	-57	-52.2	-46	-75.4	-0.51
Natural	-94	-81.0	-40	-93.0	-0.47
Spray	+50	-	+19	-	+0.76
Spray and Mow	-40	-72.4	-32	-97.0	-1.05
Total	-93	-19.5	-262	-61.9	-0.71

Figure 23 shows that though there was an increase in tern adult numbers from 2005 to 2006 for the created sites, there was a precipitous drop in fledgling numbers which led to a drop in the fledge ratio of more than 1.00. Low releases saw a drop in both adult and fledgling numbers. This could be explained by the higher flows in 2006 decreasing the amount of habitat at these sites. The steep decline in both adults and fledglings at the natural sites could be explained by the conversion of some of those sites to spray sites. Conversely, the increase of adults and fledglings at spray sites could be due to the conversion from natural sites. The decrease in the spray and mow adult and fledgling numbers is almost entirely due to the birds' abandonment of the site at RM 781.5 which went from 54 adults and 31 fledglings in 2005 to none in 2006. The table below (Figure 23) examines the created sites to determine if there were significant differences between adult, fledgling, and fledge ratio numbers between 2005 and 2006.

Figure 24. Tern Adults, Fledglings & Fledge Ratios by Created Site, Gavins Point Segment 2005-2006

Site	05 Adults	06 Adults	05 Fledge	06 Fledge	05 Fledge Ratio	06 Fledge Ratio
770*	80	176	102	46	2.55	0.52
761.3	58	40	67	29	2.31	1.45
Ponca**	68	38	12	8	0.35	0.42

*Includes the three sandbars at RM 770.2, 770.1 & 770.0
**Includes the two sandbars at RM 755.0 & 754.5

Figure 24 shows that the number of adults more than doubled at the RM 770 complex in 2006, but that the number of fledglings was less than half compared to 2005. U.S. Geological Survey researchers believed that predation of tern chicks was the cause for the drop in fledglings at this site. The created site at RM 761.3 saw a moderate decrease in adults, fledglings, and fledge ratios, but the 2006 fledge ratio of 1.45 was above the BiOp goal of 0.94. The Ponca complex saw a substantial decrease in adult numbers and a moderate decline in fledglings, which led to an increase in the fledge ratio between the two years. However, the 0.42 fledge ratio for 2006 was less than half the BiOp goal.

The other big decline in adult and fledgling numbers occurred on the natural sites. Several of these sites were converted to spray sites in 2006, which could be a partially explain the decline. The Figure below (Figure 25) compares differences between sites that were natural sites in 2005 and became spray sites in 2006 and sites that were natural in both 2005 and 2006.

Figure 25. Piping Plover Adults and Fledglings Natural 2005/Spray 2006 vs. Natural in both 2005 and 2006

Type	2005/2006 Adults	2005/2006 Fledglings	2005/2006 Fledge Ratios
Natural 2005/Spray 2006	46/50	23/19	1.00/0.76
Natural 2005/Natural 2006	72/22	20/3	0.56/0.27

Figure 25 shows several things. The sites that were natural sites in 2005 and became spray sites in 2006 were much more productive than the sites that stayed natural in both years (1.00 vs. 0.56 fledge ratio). The natural sites (in 2005) that were sprayed in 2006 had a slight increase in adults, but had fewer fledglings in 2006 for a lower fledge ratio in 2006 compared to 2005. The natural sites in 2005, that stayed natural in 2006, had a large drop off in both adults and fledglings which resulted in a greater than 50% drop off in the fledge ratio between the two years. This decline can be attributed to two colonies, RM 802.5 (2005: 34 adults, 9 fledglings, 2006: 6 adults, 0 fledglings) and at RM 788.5 (2005: 30 adults, 9 fledglings, 2006: 10 adults, 3 fledglings). Between the two, there was a net decline of 48 adults and 16 fledglings.

Habitat Rehabilitation on Lewis & Clark Lake

In 2006, there were no least tern adults or nests recorded on Lewis & Clark Lake. The spraying of sandbars in the upper end of the lake, therefore, did not attract any terns to the lake during the nesting season.

Habitat Rehabilitation on the Fort Randall River Segment

In the fall of 2005, sandbars at RM 870.2, 869.5 (partially), 866.7, 866.5, 863.7, 854.7, 854.0, 851.7, 848.5, and 846.5 were sprayed with herbicide. None of the sites were mowed to remove dead plant material. The Figure below (Figure 26) shows the nest success by habitat type on Fort Randall in 2006.

Figure 26. Least Tern Nest Success by Habitat Type – Fort Randall 2006

Habitat Type	Total	Successful	Not Successful	Not Determined	% Successful	% of Total
Natural	0	0	0	0	0.0	0.0
Spray	34	25	9	0	73.5	75.6
Spray (Natural)	11	0	11	0	0.0	24.4
Total	45	25	20	0	55.6	100.0

Terns nested on four sites in the Fort Randall segment in 2006 at RM 870.2, 866.5, 854.0, and 851.6. All of these sites were sprayed in 2005, but 11 of the 17 nests at RM 866.5 were areas that were not sprayed. The table shows that over 75% of the tern nests were on the spray sites with the rest on natural areas of a spray site. The terns were most successful on the spray sites with no successful nests being recorded on any of the non-spray sites. Figure 27 below compares total number of nests, successful nests, and nest success by habitat type between 2005 and 2006.

Figure 27. Least Tern Nest Success by Habitat Type – Fort Randall 2005-2006

Habitat Type	2005 Total Nests	2005 Successful Nests	2005 % Successful	2006 Tot. Nests	2006 Successful Nests	2006 % Successful
Natural	63	35	55.6	11	0	0.0
Spray	0	0	0.0	34	25	73.5
Total	63	35	55.6	45	25	55.6

Figure 27 shows that there were fewer nests and fewer successful nests in 2006 compared to 2005, but that nest success was higher for nests on the spray sites in 2006 (73.5%) compared to the nest success on the natural sites in 2005 (55.6%). The figure below (Figure 28) examines tern use of sandbars that were natural sites in 2005 and then were converted to spray sites for the 2006 nesting season.

Figure 28. Least Tern Nests Natural vs. Spray

River Mile	Year Last Used by Terns	#Nests/# Successful	Year Work Performed	2006 Use Nests/Hatched
870.2	2005	11/5	2005	5/4
869.5 (Portion)	2004	15/5	2005	0
866.7	2002	3/0	2005	0
866.5 (Natural)	2005	20/15	2005	11/0
866.5 (Spray)	2005	0/0	2005	6/0
863.7	Never	-	2005	-
854.7	2004	14/8	2005	0
854.0	2005	17/12	2005	22/20
851.7	2005	11/1	2005	1/1
848.5	2002	13/0	2005	0
846.5	Never	-	2005	-

Figure 28 shows that all the spray sites used in 2006 had been used by the terns in 2005. At three of the four sites, the number of nests decreased (RM 870.2, RM 866.5, and RM 851.7), while one site had a modest increase (RM 854.0). RM 870.2 had a slight decrease in successful nests. At RM 866.5, the successful nests went from 15 to 0 and at RM 854.0 went up from 12 to 20. At RM 851.7, the success stayed the same. Four of the spray sites in previous years had tern nests (RM 869.5, RM 866.7, RM 854.7, and RM 848.5), but the spraying of these did not entice the terns to re-colonize these sandbars in 2006. Two sandbars (863.7 and 846.5) that were sprayed and never had tern nests in previous years were not used by the terns for nesting in 2006.

In measuring the effectiveness of rehabilitated habitat on the Fort Randall Segment adult numbers, fledgling numbers and fledge ratios need to be examined. In 2006, there were 55 adults, 19 fledglings and a fledge ratio of 0.69 fledglings per adult pair for least terns on Fort Randall. By habitat type the numbers are as follows: 1) natural – 14 adults, 0 fledglings, 0.00 fledge ratio; and, 2) spray – 41 adults, 19 fledglings, 0.93 fledge ratio. At RM 866.5 (a spray site), of the 20 adults at this site, 12 were associated with nests in natural sites and 8 were associated with nests in spray sites.

Tern adults were more numerous and did better in raising chicks at the spray sites compared to the natural sites in 2006. Figure 29 compares the 2006 numbers to 2005 when the spray sites were natural sites.

Figure 29. Least Tern Natural vs. Spray Sites 2005 – 2006

Site	2005 Adults	2006 Adults	2005 Fledge	2006 Fledge	2005 Fledge Ratio	2006 Fledge Ratio
870.2	14	6	4	0	0.88	0.00
866.5 (N)	32	12	0	0	0.00	0.00
866.5 (S)	-	8	-	0	-	0.00
854.0	8	22	14	19	3.50	1.73
851.7	14	5	0	0	0.00	0.00
Total	68	53	18	19	0.53	0.72

Figure 29 shows that RM 870.2 had productivity in 2005 as a natural site and no productivity as a spray site in 2006 and that the sites at RM 866.5 and RM 851.7 had no productivity for either 2005 or 2006. The site at RM 854.0 was a highly productive site in 2005 and was favored by the terns in 2006. Overall, due to higher adult numbers on previously non-productive sandbars at RM 866.5 and RM 851.7 in 2005, the terns had a higher fledge ratio in 2006 (0.72) for the sites that were converted from natural sites to spray sites compared to 2005 (0.53). However, there is not definitive proof that the higher fledge ratio was due to spraying of vegetation or that it was due to some unknown favorable condition on the sandbar at 854.0

U.S. Geological Survey Least Forage Ecology Study

As in 2005, the USGS Northern Prairie Wildlife Research Center continued its least tern forage ecology and productivity study on the Gavins Point Segment in 2006. This study began in 2005 and will continue in 2007. Study objectives related directly to the created sandbars include: 1) compare habitat characteristics of natural and created sandbars at landscape and sandbar scales; 2) compare estimated nest numbers, nest survival, and reproductive success of least tern nests on natural and created sandbars; 3) assess least tern foraging activity and capture rates in proximity of created and natural emergent sandbar habitat; and 4) assess least tern prey abundance in relation to proximity to known tern foraging habitat, and created and natural emergent sandbar habitats.

Reasonable and Prudent Measure 5 – Evaluate Effective Measures to Reduce Least Tern Predation

In 2005, least tern predator exclosures used on the Kansas River were evaluated for possible use on the Missouri River. They were, however, deemed to be too large and, therefore, impractical to install in the large tern colonies. There was no trapping or removal of predators to protect least terns on the Missouri River system in 2006. However, due to excessive losses on the Gavins Point River Segment, trapping and/or removal is being considered for the 2007 nesting season.

Reasonable and Prudent Measure 6 – Reduce Human Disturbance of Least Terns and Conduct Outreach and Education

Two least tern nests were destroyed by humans on the Missouri River in 2006. Both nests were destroyed in the same incident. The Gavins Point crew had discovered three least tern nests on a very small sandbar at RM 795.5 on July 5, 2006. On the next site visit on July 12, it was found that two of the nests, 0610243 – three eggs, and 0610244 – one egg, had been destroyed. There were numerous barefoot human footprints on the sandbar and beer cans had been placed over the tongue depressors that serve as nest markers (Photograph 10). The third tern nest (0610469), which contained one egg, was considered to be still viable. Prior to the incident, restriction signs had not been placed on the sandbar. A restriction sign was placed on the sandbar to protect the sole remaining nest. This nest was later destroyed when a goose stepped on the egg.

To deter human disturbance and increase awareness of endangered species, restriction signs and spacer stakes with orange twine were placed around least tern nesting sites. The signs, stakes, and twine created a "psychological barrier" that delineated the nesting sites for the public. Listed below are the sites where restrictions were posted.

Lake Sakakawea: During the 2006 season, more preemptive measures were taken to deter infractions on Corps fee title land. "No off road vehicles" signs were placed at Tobacco Garden (RM 1511) and Red Mike (RM 1510) and a fence was installed at the Little Egypt recreation area to discourage off road vehicles. In addition to the signs and fence, a seasonal ranger was assigned to patrol shoreline areas, including endangered species habitat, to deter off-road vehicle use. The ranger issued fourteen citations, 125-150 verbal warnings, one written warning, and two courtesy warnings during the summer.

Missouri River below Garrison Dam: Restriction signs were placed around nesting sites on the sandbar at Heskett (RM 1319.5) and Eagle's Nest (RM 1308.5).

Photograph 10. Tern Nest Destroyed by Human Disturbance

Lake Oahe: Restriction signs were placed around nesting sites at State Line (RM 1232.0), Vander Laan (RM 1225.0), Old Railroad Grade (RM 1199.0), Blue Blanket (RM 1189.0), Okobojo Creek (RM 1089.5), and at Peoria Flat (RM 1083.0).

Lake Francis Case: A small least tern colony was found near the North Point Campground (RM 881). The area was posted with restriction signs and fenced by Fort Randall Project personnel. The site was monitored by South Dakota Game, Fish & Parks personnel to prevent North Point campers from disturbing the colony.

Missouri River below Fort Randall Dam: Sandbars at RM 870.2, 866.5, and 854.0 were fenced and signed.

Missouri River below Gavins Point Dam: Restriction signs and orange twine fencing were placed around nesting sites on sandbars at RM 808.2, 804.6, 804.5, 802.5, 802.1, 801.3, 801.1, 795.9, 795.5, 795.3, 791.5,

788.5, 770.2, 770.1, 770.0, 761.3, 756.6, and 755.0. In addition to Corps restriction signs, a private landowner used yellow police barricade tape at RM 801.3 to delineate the least tern nesting area.

Protection of least tern nesting sites was coordinated with law enforcement officers from the South Dakota Game, Fish & Parks Department. Officers from this agency conducted deterrence patrols throughout the nesting season on the Fort Randall and Gavins Point Segments.

Outreach efforts in 2006 included presentations before civic organizations, schools, environmental groups, and at campfire programs, the writing of articles for area newspapers, and the distribution of the "Missouri River Species at Risk" brochure to area businesses and the public.

RPM 7 – Revise Contingency Plan for Moving Eggs

A revised contingency plan for moving least tern eggs was developed in 2004 and submitted to the Service. In 2006, four least tern nests were raised and moved, eight nests were moved but not raised, and eighteen nests were raised but not moved. In all cases, the nest moving, raising, and move/raises were done to prevent the nests from being lost due to increased releases from dams on the Missouri River. Of the four nests that were raised and moved, all were subsequently lost to flooding. See the Incidental Take section for further information (page 32). Of the eight nests that were moved, two were successful, two were lost to weather events, one was lost to predation, two were abandoned, and one had an undetermined fate. Of the eighteen nests that were raised, fifteen were successful, one was lost to weather, one to predation and one was abandoned. Overall for the 30 nests, 17 were successful (56.7% nest success), 12 were unsuccessful (4 flooded, 3 weather, 3 abandoned, 2 predated), and 1 was undetermined.

Because least tern chicks are dependent upon their parents to feed them fish, they cannot be moved from their natal areas. Therefore, portions of small sandbars at RM 797.3 and RM 781.4 were built up in July 2006 to prevent the chicks from being washed away due to increased releases out of Gavins Point Dam to meet flow targets in the navigation channel on the lower river. A platform was created for one tern chick at RM 797.3, and a platform was created for two brood mates at RM 781.4. The chick at RM 797.3 was lost when an increase in releases washed over the raised platform. The platform at RM 781.4 withstood the increased releases, but the two chicks later succumbed to the West Nile virus. See the chick mortality section for further information (page 29).

II.C.2. Piping Plover Summary

The 2003 BiOp Amendment, the RPA Habitat/Fledge Ratio Goals for piping plovers were "to be determined as the recent (past) 3-year running average." In the 2000 BiOp, the piping plover fledge ratio goal was set at 1.13 fledglings per adult pair. However, on page 214 of the 2003 BiOp Amendment, the Service stated that "These fledge ratios have been superseded by those found in the incidental take statement of this document." In the incidental take statement of the 2003 BiOp amendment (pgs. 247-250), system wide fledge ratios are listed for only Conditions 5: Take of eggs in nests assigned fates of destroyed-unknown, nest abandonment, sandbar erosion and unknown fates) and Condition 6: Take of chicks as a result of insufficient forage on created habitats. The Service determined that for the eleven year period of 1993-2003 on the Missouri River the piping plover fledge ratio was 1.36 fledglings per adult pair. The Service determine for Conditions 5 anad 6 "anticipated that fledge ratios … will be within 10 percent of the fledge ratio that has been observed during the period 1993-2003, 1.36 – i.e., 1.22-1.47."

It is the Corps of Engineers interpretation that the crucial fledge ratio is the lower part of the 10% of 1.36, i.e., the 1.22 fledglings per adult pair and that, for purposes of the 2003 BiOp Amendment RPA Habitat/Fledge Ratio Goals for piping plovers, the three year running average of 1.22 needs to be met to be in compliance with the RPA.

Habitat/Fledge Ratio Goals

Figure 30 shows the Corps did not meet the three-year (2004-2006) fledge ratio goal of 1.22 fledglings per adult pair for piping plovers with a three-year fledge ratio of 1.16 fledglings per adult pair.

Figure 30. Three-Year (2004-2006) Fledge Ratio for Piping Plovers (Required 1.22)

	Adult Census	Fledged Juveniles	Fledge Ratio
2004	1587	1179	1.49
2005	1764	1016	1.15
2006	1311	504	0.77
3 Yr. Total (2004-2006)	4662	2699	1.16

For comparative purposes, the chart below (Figure 31) shows the three year piping plover fledge ratio running average for 1986-1988 through 2004-2006. The chart shows that the Corps has not met the 1.22 fledgling per adult pair goal for the first time in eight years.

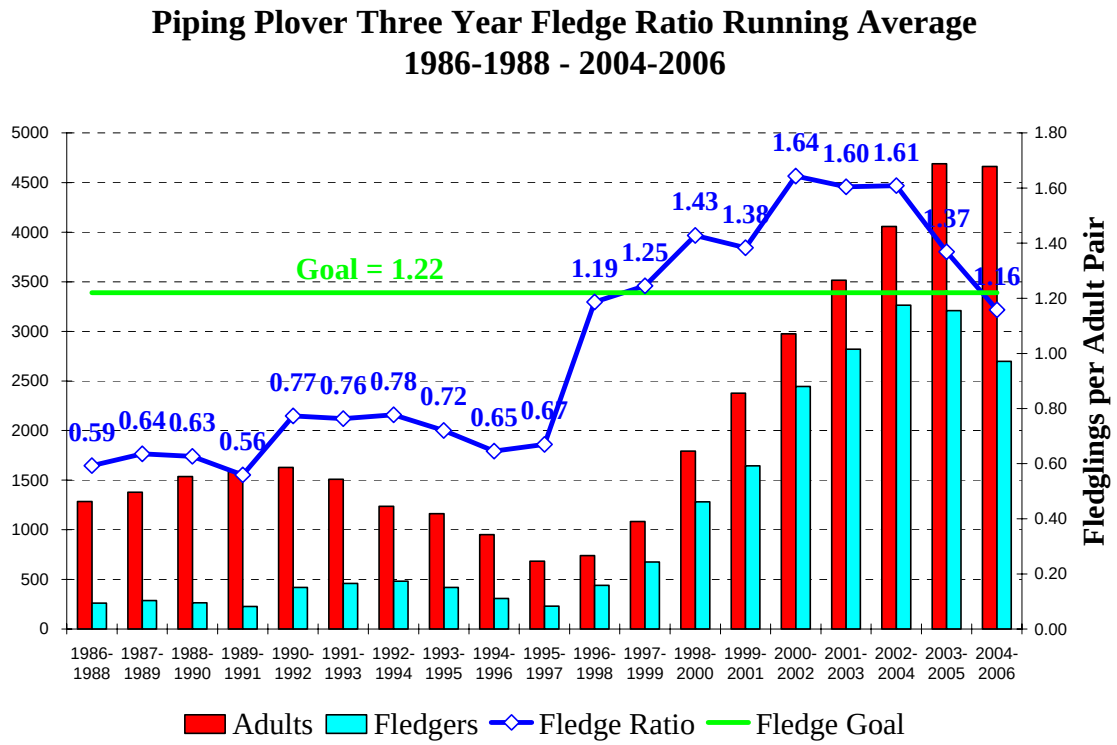


Figure 31. Piping Plover Three Year Fledge Ratio Running Average

Incidental Take Statement

The Service, in the 2003 BiOp Amendment, listed six categories in which incidental take was expected to occur. Listed below is the analysis for incidental take for each of the six categories.

1. Take (killing) of eggs and chicks by flooding on the river and reservoir reaches that results from the Corps operation of the water control system

In the 2003 BiOp Amendment, the Service set two standards of incidental take in regard to Corps operations:

1. Incidental take should not exceed by more than 10% of a ten year weighted average of 8.4% (the amount of take resulting from Corps operations from 1993-2003). The 10% variance results in a lower limit of 7.6% and an upper limit of 9.2%.

2. Take should not exceed that observed from 1993-2003 in any single year. This was quantified as the lesser of 296 eggs (1995) or 46% of all eggs (1996).

In 2006, 127 of 2,636 piping plover eggs (4.8%) were lost due to Corps operations. This is below both the 296 eggs and the 46% of all eggs standards set forth in the 2003 BiOp amendment. However, it was an increase compared to the 110 plover eggs that were lost to Corps operations in 2005. The ten year weighted running average of plover eggs lost to Corps operations, 1997-2006, was 3.8% (748/19,455). This is well below the 9.2% upper limit of losses set by the Service in the 2003 BiOp Amendment. The 127 piping plover eggs lost in 2006 came from 42 nests and were the result of four operational events.

The first event was an increase in releases from Gavins Point Dam from 15,000 cfs on May 13 to 24,000 cfs on May 17. The releases were increased to simulate a "spring rise" of the river to provide a spawning cue for the endangered pallid sturgeon. A total of fourteen piping plover nests with 35 known eggs and five estimated eggs were lost. Below is a list of the nests that were lost. The nests are listed by RM and nest ID. "Known eggs" are the number of eggs in the clutch the last time the nest was visited. "Estimated eggs" are the number of eggs the female could have laid after the last visit, assuming an egg is laid every other day and that a full clutch is four eggs. Nests found by the Virginia Polytechnic Institute (VPI) research crew that were not found by the Corps of Engineers crew are denoted by VPI.

All the nests except one were inundated by the increased releases. The sole exception was nest 0610005 at RM 791.5. This nest was moved to a higher location to prevent its loss, but adults were not observed at the site while the nest was being moved. The nest was found abandoned on the subsequent nest visit. Losses by location and Nest ID are as follows:

First Event Nest Losses

RM 808.2: 0610003 – 3 known eggs, 1 estimated egg; 0610004 – 3 known eggs, 1 estimated egg

RM 804.5: 0610002 – 2 known eggs, 2 estimated eggs; 0610008 – 3 known eggs, 1 estimated egg – VPI; 0610009 – 4 known eggs – VPI; 0610010 – 4 known eggs – VPI; 0610011 – 3 known eggs – VPI; 0610012 – 3 known eggs – VPI; 0610075 – 1 known egg – VPI; 0610076 – 1 known egg – VPI

RM 803.4: 0610013 – 2 known eggs – VPI

RM 802.1: 0610078 – 3 known eggs – VPI

RM 791.5: 0610005 – 2 known eggs

RM 770.0: 0610077 – 1 known egg – VPI

The second event was the loss of eighteen nests and 56 known eggs and fourteen estimated eggs on Lake Sakakawea. The losses were due to the reservoir rising during the nesting season. Lake Sakakawea is operated to rise from May through July to capture snow pack runoff from the Yellowstone River Basin. At the beginning of the nesting season on May 1, 2006, the lake level of Lake Sakakawea was at 1812.5 feet msl. During the nesting season, the lake rose nearly five feet and peaked on July 1, 2006 at 1817.4 feet msl. Losses by location and Nest ID are as follows:

Second Event Nest Losses

Van Hook East: 063233 – 3 known eggs, 1 estimated egg

Van Hook Southeast: 063217 – 1 known egg, 2 estimated eggs

Van Hook Southwest: 063234 – 1 known egg, 3 estimated eggs

Deepwater Bay North: 063016 – 4 known eggs

Deepwater Bay South: 603031 – 1 known egg, 3 estimated eggs

Deepwater Island: 06343 – 4 known eggs

Arikara Bay North: 063037 – 4 known eggs

Elbowwoods Bay: 06358: 3 known eggs

Renner: 063065 – 2 known eggs, 2 estimated eggs

Garrison Cottage: 06373 – 4 known eggs

De Trobriand 1: 063034 – 4 known eggs

Steinke Bay: 063006 – 3 known eggs, 1 estimated egg; 063036 – 3 known eggs, 1 estimated egg; 063038 – 3 known eggs, 1 estimated egg

Seven Sisters: 063021 – 4 known eggs; 063027 – 4 known eggs; 063029 – 4 known eggs

Island Northeast of the Northeast part of Mallard: 064053 – 4 known eggs

The third event was an increase of releases from Garrison Dam from an average of 19,000 cfs to an average of 21,000 cfs. The increase occurred on June 8, 2006 and was done to slow down the decline in the lake level of Lake Oahe. The action resulted in the loss of four plover nests containing sixteen known eggs on the Garrison Segment and the loss of five plover nests containing sixteen known eggs and four estimated eggs on Lake Oahe. Losses by location and Nest ID are as follows:

Third Event Nest Losses

Garrison River:

RM 1310: 064204 – 4 known eggs; 064242 – 4 known eggs

RM 1309: 064206 – 4 known eggs

RM 1304: 064207 – 4 known eggs.

Lake Oahe:

RM 1284.0 (Barrels): 065211 – 4 known eggs

RM 1273.3 (South Rice): 065212 – 4 known eggs

RM 1271.5: 065215 – 1 known egg, 3 estimated eggs

RM 1268.5 (Cannonball): 065217 – 3 known eggs, 1 estimated egg

RM 1266.6 (OJ Flats): 065221 – 4 known eggs.

The fourth event was a stepped increase of releases from Gavins Point Dam from 25,000 cfs on July 21, 2006 to 30,000 cfs by August 1, 2006. The increase was done to meet the navigation target for barge traffic on the channelized portion of the Missouri River. One nest containing four eggs was lost. The nest was

0610499 and was on a small sandbar at RM 781.4. The nest was raised on July 21 to prevent its loss due to the increased releases. The nest was found to be okay on visits on July 24 and July 27. However, the increase in releases throughout the week reduced the size of the sandbar and made the raised area attractive to Canada geese. On a site visit on July 31, it was found that three of the four eggs had been stepped on by geese and the nest had been abandoned by the adults.

During the 2006 nesting season, three other piping plover nests were lost to flooding. These flood losses were not caused by Corps operations and are examined below.

Garrison River:

RM 1374.0 – Nest 064001: This four-egg nest was listed as normal and not at risk on May 26. On June 3, the nest was listed as destroyed with the eggs washed out. Releases out of Garrison Dam averaged 18,400 cfs on May 26. Between May 26 and June 3 the highest average daily releases occurred on May 27 when the releases averaged 18,600 cfs.

Lake Oahe:

RM 1291.9 – Nest 065269: This four egg nest was listed as normal and not at risk on June 15. On June 23, the nest was listed as destroyed with the eggs washed out. The closest river gauge to the nest is located at Bismarck, North Dakota. On June 15, the highest gauge reading at Bismarck was 7.15 feet. The high water mark on the Bismarck gauge between June 15 and June 23 occurred at 0000 hours on June 16, when the gauge was 7.16 feet. With a maximum rise 0.01 feet between site visits, Corps operations were not responsible for the loss of the nest.

RM 1232.0 – Nest 065134: This four egg nest was listed as normal and not at risk on May 30. On June 7, the nest was listed as destroyed with the eggs washed out. On May 30, the lake level was at 1577.0 feet msl. Between May 30 and June 7, the lake level declined 0.4 feet to 1576.6 feet msl, therefore, Corps operation of the lake was not responsible for the loss of the nest.

2. Take (harm) of eggs, chick or adults by predation

In the 2003 BiOp Amendment, the Service noted that 4.0% of monitored nests were lost to predation from 1993-2003. The Service expected take could be quantified as being outside of a 10% variance of that 4.0% loss and set loss from predation as being from 3.6% to 4.4% as a ten year weighted running average. In 2006, 48 of 760 plover nests were lost to predation for a loss rate of 6.3%. The ten year weighted running average, 1997-2006, was 4.1% (222/5462), which was within the 3.6%-4.4% tolerance set forth in the 2003 BiOp Amendment.

3. Take (harm) of eggs, chicks or adults by human disturbance

In the 2003 BiOp Amendment, the Service did not consider take from human disturbance on the reservoir reaches and quantified take only from the riverine segments. The Service noted that 1.5% of monitored nests on the riverine segments were lost to human disturbance from 1993-2003. The Service expected take could be quantified as being outside of a 10% variance of that 1.5% loss and set loss from human disturbance as being from 1.4% to 1.7% as a ten year weighted running average. In 2006, 2 of 346 plover nests on the riverine segments were lost to human disturbance for a loss rate of 0.6%. The ten year weighted running average, 1997-2006, was 1.2% (28/2271), which is below the 1.4%-1.7% tolerance set forth in the 2003 BiOp amendment.

4. Take (harm) of chicks as a result of insufficient forage in river reaches affected by hypolimnetic releases

The Service, in the 2003 BiOp Amendment, noted that hypolimnetic hydropower releases from Fort Peck, Garrison, and Fort Randall Dams would continue to provide unsuitable water temperatures below the dams and negatively impact production at all trophic levels. The Service quantified take in the form of fledge

ratios for these three segments with a variance of not to exceed by more than 10% the fledge ratios on these segments for 1993-2003. The 1993-2003 fledge ratio for below Fort Peck Dam was 1.33 (1.20-1.46 variance), for below Garrison Dam the fledge ratio was 1.18 (1.06-1.30 variance), and for below Fort Randall Dam the fledge ratio was 0.92 (0.83-1.01 variance).

The Service made no mention of a ten year weighted running average for these fledge ratios, but, since ten year weighted running averages were used for the other five measures of take, it is Corps interpretation that this was an omission on the part of the Service and have included the ten year weighted running average along with the 2005 fledge ratios.

For the Fort Peck River Segment, the 2006 fledge ratio was 0.40, while the ten year weighted running average for 1997-2006 was 1.00 (27 fledglings/27 adult pairs). This is below the 1.20 lower limit fledge ratio set forth in the 2003 BiOp Amendment.

For the Garrison River Segment, the 2006 fledge ratio was 0.77, while the ten year weighted running average for 1997-2006 was 1.25 (816 fledglings/653 adult pairs). This is within the 1.18 to 1.30 variance fledge ratio set forth in the 2003 BiOp amendment.

For the Fort Randall River Segment, the 2006 fledge ratio was 0.38, while the ten year weighted running average for 1997-2006 was 0.91 (173 fledglings/190 adult pairs). This is within the 0.83-1.01 limits fledge ratio set forth in the 2003 BiOp amendment.

5. Take (harm) of eggs in nests assigned fates of destroyed-unknown, nest abandonment, sandbar erosion, and unknown fates

The Service, in the 2003 BiOp Amendment, noted that the 1993-2003 fledge ratio for piping plovers on the Missouri River system was 1.36 fledgling per adult pair. The Service quantified take for nests assigned fates of destroyed unknown, nest abandonment, sandbar erosion, and unknown fates as being greater than 10% variance from that fledge ratio (1.22-1.47) for a ten year weighted running average. The ten year weighted running average for 1997-2006 was 1.36 (6832 fledglings/5029 adult pairs) which is within the 10% variance set by the USFWS.

6. Take (harm) of chicks as a result of insufficient forage on created habitats

In the 2003 BiOp Amendment, the Service noted that piping plover chicks may starve on created habitats due to insufficient forage. The Service anticipated that fledge ratios in the created habitats would approximate those for observed from 1993-2003, in that, 1.36 fledglings per pair. The Service, in the 2003 BiOp Amendment, stated that there may be a variance of as much as 10% from the 1.36 fledge ratio and, therefore, set a range of 1.22-1.47 fledge ratios based on a ten year running average was set for take compliance. The Corps habitat creation efforts in the early 1990s were destroyed by high releases from the Garrison, Fort Randall and Gavins Point Dams in 1995, 1996, and 1997. Habitat was created at three sites (RM 770.0, RM 761.3, and 755.0) in 2004 and 2005. The fledge ratio for these created habitat sites is, therefore, based on the three past years of habitat creation and not the ten year running average. For 2004-2006, the fledge ratio for created habitat was 1.62 fledglings per adult pair (251 fledglings/155 adult pairs) which exceeded 1.47 upper limit set forth in the 2003 BiOp Amendment. The below figure (Figure 32) shows the one year, two year, and three year fledge ratios for the created sandbars.

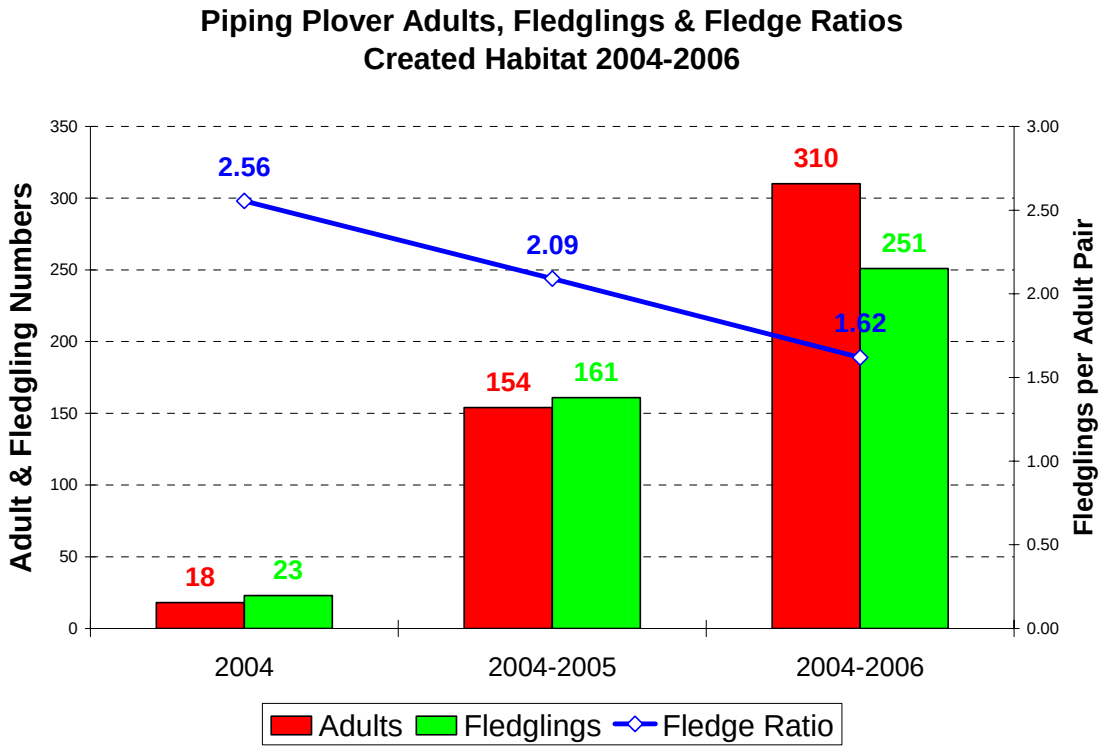


Figure 32. Piping Plover Adults, Fledglings and Fledge Ratios for Created Habitat (2004-2006).

Reasonable and Prudent Measures to Minimize Take

The Service listed several RPMs in the 2003 BiOp Amendment to minimize take of piping plovers on the Missouri River. Corps compliance measures for the RPMs are listed below.

Piping Plover Reasonable and Prudent Measure 1 – "The Corps shall survey and monitor all plover sites on the Missouri and Kansas Rivers…"

RPM 1.1. Annual Piping Plover Monitoring Program

Missouri River

Monitoring of piping plover nesting sites on the Missouri River was conducted by Corps personnel on the Missouri River below Fort Peck, Garrison, Fort Randall, and Gavins Point Dams, on Lake Sakakawea, Lake Oahe, Lake Francis Case, and Lewis and Clark Lake. Service personnel monitored Lake Audubon National Wildlife Refuge and an adjacent part of Lake Sakakawea under a contract. Dr. Roger Boyd, Biology Department, Baker University, monitored the Kansas River under a contract.

The first piping plover observation for 2006 occurred on April 26 with the observation of piping plovers at several sandbars on the Missouri River below Gavins Point Dam. At least one pair of plovers was in the basin much earlier than that as the earliest nest initiation was on April 17, 2006 in the Red Mike area of the upper part of Lake Sakakawea in North Dakota. Two pairs tied for the latest nest initiation, both on July 19, 2006. One occurred on Fort Peck Lake on a beach adjacent to the dam and the other occurred on Lake Oahe on the shoreline north of Swiftbird Bay. The figure below (Figure 33) shows the productivity and adult census results by segment for the 2006 nesting season.

Figure 33. Result of 2006 Adult Census and Monitoring Effort of the Piping Plover

	Adult Census	**Nests**	**Nests Hatched**	**Nest Success (a)**	**Total Chicks Fledged**	**Fledge Ratio (b)**
Segment 1 - Fort Peck Lake	20	7	6	85.7	12	1.20
Segment 2 - Missouri River Below Fort Peck Dam	5	1	1	100.0	1	0.40
Segment 3 -Lake Sakakawea	430	146	74	50.7	131	0.61
Segment 4 - Missouri River below Garrison Dam	175	109	52	47.7	67	0.77
Segment 5 -Lake Oahe	331	216	110	50.9	164	0.99
Segment 7 -Lake Francis Case	0	0	0	0.0	0	0.00
Segment 8 - Missouri River below Fort Randall Dam	37	20	9	45.0	7	0.38
Segment 9 -Lewis and Clark Lake	4	3	2	66.7	1	0.50
Segment 10 - Missouri River below Gavins Point Dam	309	206	116	56.3	121	0.78
Total	**1311**	**708**	**370**	**52.3**	**504**	**0.77**

(a) Nest Success = HN/N, where HN= hatched nests and N=number of nests
(b) Fledge Ratio = number of fledged chicks per pair of adult birds

With 1,311 adult piping plovers counted, 2006 marked the fifth consecutive year that the Missouri River recovery goal of 525 piping plover pairs (1,050 adults) was exceeded. However, 2006 marked the first time in nine years that piping plover adult numbers decreased on the Missouri, falling 25.7% from 2005's record number of 1,764. The below figure (Figure 34) tracks piping plover adult and fledgling numbers from 1986 through 2006.

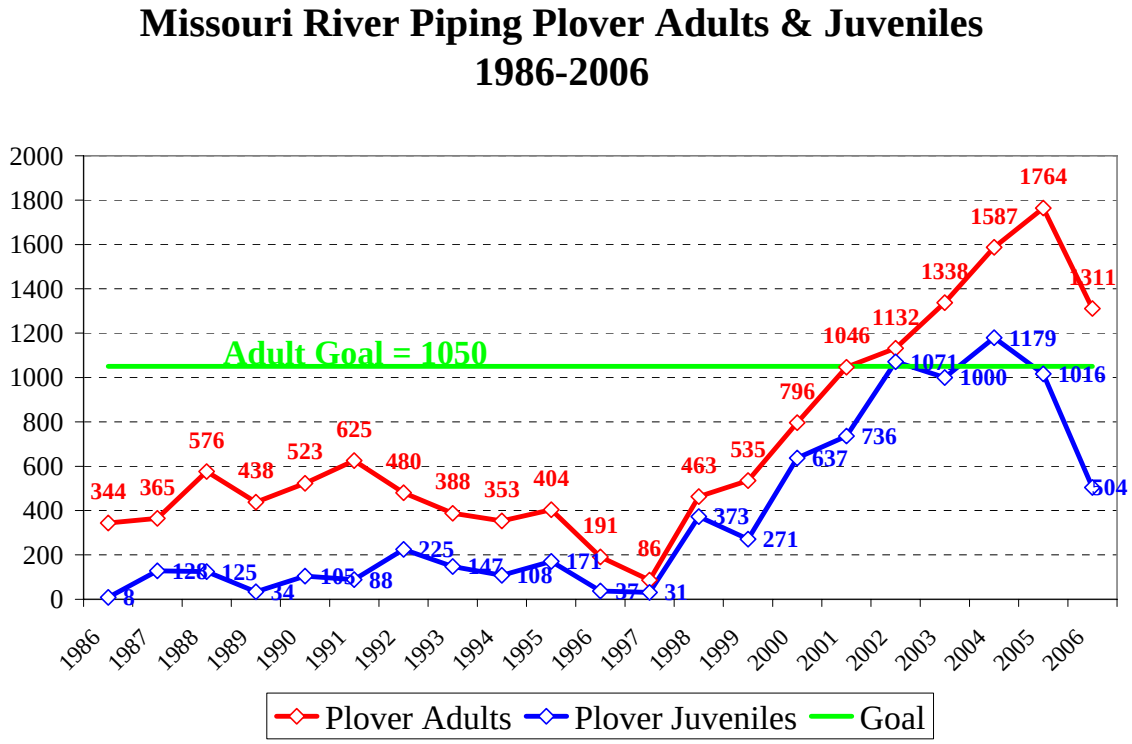


Figure 34. Missouri River Piping Plover Adults and Juveniles (1986-2006)

The figure below (Figure 35) shows the adult piping plover distribution by segments. The segments have been color coded with green representing riverine segments and blue representing reservoir segments. Due to low lake levels, the upper part of Lake Oahe is more riverine in nature than reservoir. Therefore, Lake Oahe has been divided into Lake Oahe River and Lake Oahe.

Total = 1,311

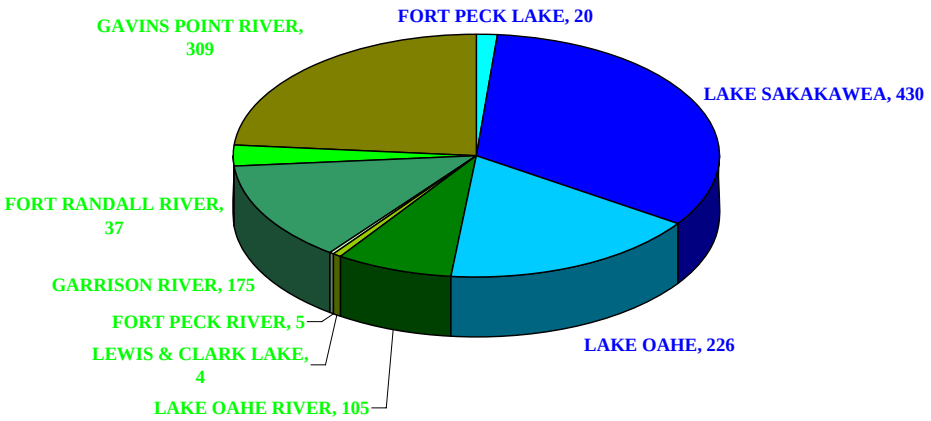


Figure 35. Adult Piping Plover Distribution by Segments (2006)

Figure 35 shows that a little more than half of the plovers, 51.6% (676/1311) were on reservoir segments compared to riverine segments. This continues a trend where least terns are seen on reservoir segments over riverine segments. Figure 36 compares piping plover adult numbers by segment for 2005 and 2006.

Figure 36. Piping Plover Adults by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	26	20	-6	-23.1
Fort Peck River	2	5	+3	+150.0
Lake Sakakawea	746	430	-316	-42.4
Garrison River	220	175	-45	-20.5
Lake Oahe	364	331	-33	-9.1
Fort Randall River	42	37	-5	-11.9
Lewis & Clark Lake	24	4	-20	-83.3
Gavins Point River	340	309	-21	-6.2
Total	1764	1311	-453	-25.7

With the exception of an insignificant rise in adult numbers on the Fort Peck River Segment, piping plover numbers were down on all of the other Missouri River Segments. The largest decline was on Lake Sakakawea, with 316 adults accounting for nearly 70% (316/453) of the total decline on the Missouri River. The sharp decline in piping plover numbers on Lake Sakakawea can be attributed to loss of habitat. On May 1, 2005, the elevation of Lake Sakakawea was at 1806.6 feet msl. On May 1, 2006, the elevation of the lake was at 1812.5 feet msl, a gain of nearly six feet at the start of the nesting season. This rise in the lake submerged shoreline habitat. This, combined with the continued encroachment of vegetation on the shoreline, further squeezed the piping plover habitat into a narrow band of shoreline around the lake. The Garrison River Segment saw the next largest decline in plover adult numbers with a drop of 45 adults and a 20% decline from 2005. No one factor can be identified to explain this decline. The second and third largest segments by adult numbers, Lake Oahe and Gavins Point, also saw declines, but these were modest compared to Lake Sakakawea both in real numbers (33 and 21) and by percent (9% and 6%). The segment with greatest percent decline was Lewis & Clark Lake, which lost 83% of its 2005 adults. The decline in numbers on Lewis & Clark Lake can be attributed to the plover's abandonment of the sandbars at RM 841.8 which went from 20 in 2005 to zero in 2006.

Kansas River

The Corps (Kansas City District) continued to operate the Kansas River Reservoir System in FY 2006 to provide overall benefits to the conservation of endangered interior least terns and threatened piping plovers. This is in accordance with the BiOp.

Dr. Roger Boyd of Baker University was contracted to monitor the nesting activity on the Kansas River. Two pairs of piping plovers and ten pairs of interior least terns nested on the Kansas River in 2006. Four additional pairs of least terns nested at the nearby Jeffrey Energy Center. These birds produced four piping plover nests and thirteen least tern nests on the Kansas River and four least tern nests at the Jeffrey Energy Center. Five piping plover chicks and six least terns chicks fledged from the nests on the Kansas River and three least tern chicks fledged from the nests at the Jeffrey Energy Center.

The Corps (Kansas City District) did complete a draft report examining piping plover and least tern productivity on the Kansas River from 2000 to 2005 in compliance with the BiOp. Three reviewers provided independent review of the draft report and a final report will be completed early in 2007.

RPM 1.2. Survival Information

Productivity declined for piping plovers in 2006 to 504 fledglings. This represents a 50.4% decline from 2005's 1,016 and was the lowest number of fledglings since 1999's 271 (Figure 34). The pie chart below (Figure 37) shows the fledgling distribution by segment. As with the adults, green shades indicate river segments and blue shades indicate reservoir segments and Lake Oahe has been divided into river and reservoir sections.

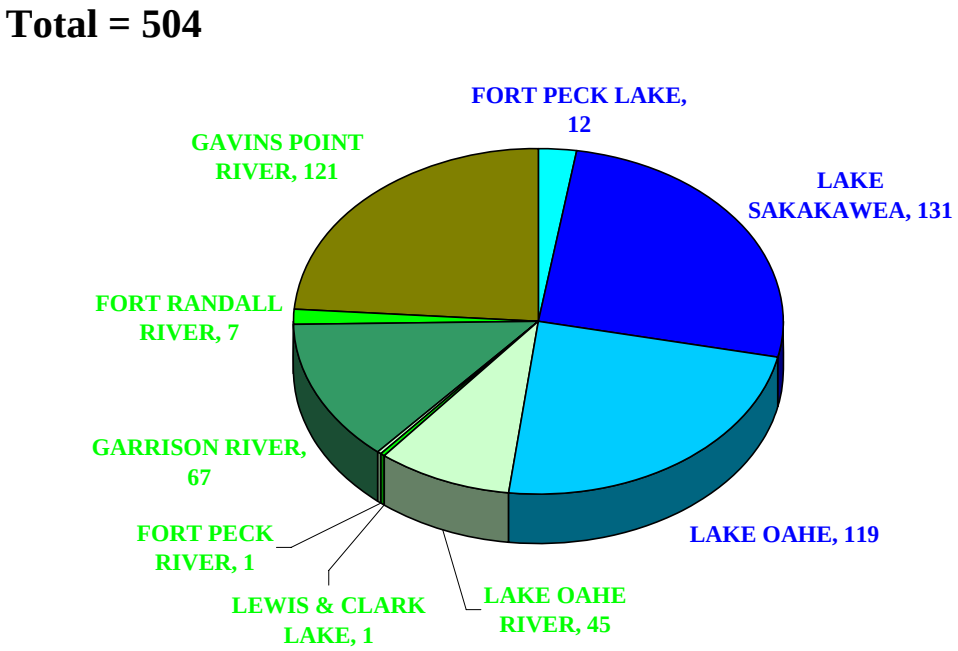


Figure 37. Piping Plover Productivity by Segment (2006)

The pie chart shows a slight favoring of the reservoir habitat by the fledglings with 52.0% (262/504) occurring on the three reservoirs compared to the riverine segments. The figure below (Figure 38) compares plover fledgling numbers by segment for 2005 and 2006.

Figure 38. Piping Plover Fledglings by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	14	12	-2	-14.3
Fort Peck River	4	1	-3	-75.0
Lake Sakakawea	333	131	-202	-60.7
Garrison River	91	67	-24	-26.3
Lake Oahe	220	164	-56	-25.5
Fort Randall River	17	7	-10	-58.8
Lewis & Clark Lake	2	1	-1	-50.0
Gavins Point River	335	121	-214	-63.9
Total	1016	504	-512	-50.4

Piping plover fledglings were down for all segments of the Missouri River in 2006 compared to 2005. The most dramatic of the decrease came from two segments, Lake Sakakawea and Gavins Point, which, together, accounted for 81% (416/512) of the decline. For Lake Sakakawea, the large decrease in adults from 2005 to 2006 can partially account for the decrease in fledglings. The decrease in habitat at the start of the nesting season was exacerbated by an increase in the lake elevation from May through mid July to capture the mountain snow pack runoff. On May 1, 2006, at the beginning of the nesting season, Lake Sakakawea had an elevation of 1812.5 feet msl. The lake then rose nearly five feet to peak at 1817.4 feet msl on July 1, 2006. This further reduced the nesting habitat and inundated several nests. See the Incidental Take section for further information (page 32). The decline in fledglings on the Gavins Point Segment will be discussed under RPM 8 on page 61.

In addition to the large declines on Lake Sakakawea and Gavins Point, the two other segments with historically large number of plover fledglings, the Garrison Segment and Lake Oahe, also saw substantial decreases of more than 25% for both segments. These losses cannot be easily explained. On the Garrison River Segment, releases were below normal from Garrison Dam, averaging around 21,000 cfs for most of the nesting season compared to a normal average of 25,000 cfs. The reduced releases would have exposed more foraging habitat for the chicks. Unlike Lake Sakakawea, the lake level on Lake Oahe was relatively stable during the nesting season. On May 1, 2006, the lake was at elevation 1,577.4 feet msl, peaked at less than a half a foot higher at 1,577.8 feet msl on May 18, 2006, and then slowly declined through the rest of the nesting season. This would have provided stable foraging habitat for the chicks.

The overall fledge ratio for piping plovers on the Missouri River was 0.77 fledglings per adult pair in 2006. This marks the fourth consecutive annual decline in the fledge ratio since 2002's record 1.89 and marks the second consecutive year that the fledge ratio was below the goal of 1.22. Figure 39 shows an annual comparison of fledge ratios for piping plovers on the Missouri River from 1986 through 2006.

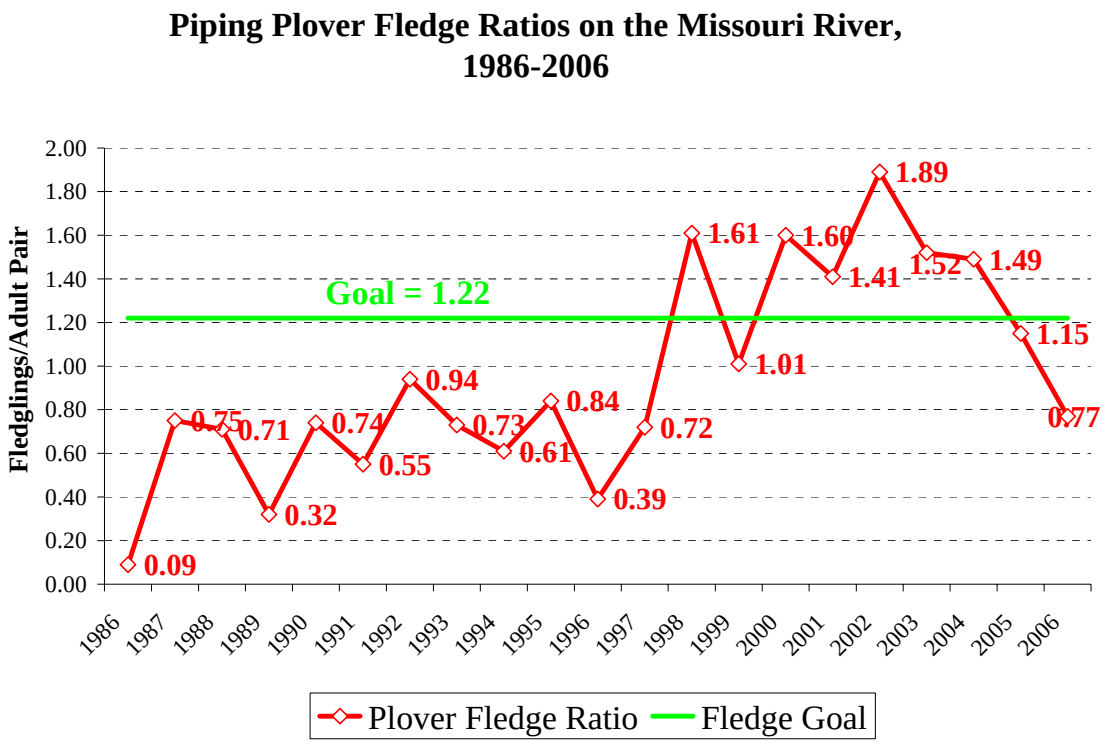


Figure 39. Piping Plover Fledge Ratios on the Missouri River

It should be remembered that the above chart is for annual comparison. For habitat requirements of the BiOp, the measure is a three year running average. As stated earlier, the three year running average, 2004-2006 was 1.16 fledglings per adult pair. The below figure (Figure 40) compares piping plover adult fledge ratio by segment for 2005 and 2006.

Figure 40. Piping Plover Fledge Ratio by Segment, 2005-2006 Comparison

Segment	2005	2006	Change	% Change
Fort Peck Lake	1.08	1.20	+0.12	+11.1
Fort Peck River	4.00	0.40	-3.60	-90.0
Lake Sakakawea	0.89	0.61	-0.28	-31.5
Garrison River	0.87	0.77	-0.10	-11.5
Lake Oahe	1.18	0.99	-0.17	-14.4
Fort Randall River	0.81	0.38	-0.43	-53.1
Lewis & Clark Lake	0.17	0.50	+0.33	+194.1
Gavins Point River	1.97	0.78	-1.19	-60.4
Total	1.15	0.77	-0.38	-33.0

None of the eight Missouri River segments that contained piping plovers met the BiOp goal of 1.22 fledglings per adult pair, though Fort Peck Lake, with a 1.20 fledge ratio, was close. Fort Peck Lake and Lewis & Clark Lake were the only two segments that showed an increase in fledge ratios between 2005 and 2006, but both represent minor numbers of adults and fledglings. The Garrison Segment and Lake Oahe showed moderate declines while Lake Sakakawea and Fort Randall River showed more substantial declines. Of particular concern was the 1.19 fledge ratio decline on the important Gavins Point Segment. This decline will be discussed under RPM 8 on page 61.

RPM 1.3. Nests and Eggs Loss

Nest Mortality: As noted in the table above, there were 708 piping plover nests on the Missouri River in 2006 and 370 of these nests had successful hatchings. Fifty-two broods that were found but could not be associated with a nest were not included in the nest total. There were 338 nests that were lost. The nest losses are categorized below. Egg losses are estimated as per RPM 1.3 which states "Methods of analysis that accurately (e)stimate the number of eggs in destroyed nests at the time of their destruction shall be used. For example, a nest is visited during the laying period before a full modal clutch size of four (Haig 1992) had been laid. On the next visit, seven days later, the nest has been destroyed. The estimate should be based on the number of eggs observed plus an assumption that the following eggs were laid at a rate of 1 egg per 1.5 days."

As noted in the 2005 Annual Report, this methodology probably overestimates egg losses since it makes two false assumptions: 1) it assumes that nest destruction does not occur until after a full four egg clutch is laid and 2) it assumes that piping plovers always lay four egg clutches. This is definitely not the case in the latter assumption, especially with re-nests where a clutch is more likely to be two or three eggs rather than the full modal clutch size of four. An analysis of the 2006 piping plover nests shows that for 602 nests, incubation had begun and, therefore, the number of eggs in the clutch was known. Of the 602 nests, 4 contained a clutch of five eggs, 472 contained four eggs, 90 contained three eggs, 25 contained two eggs and 11 contained one egg. For 2006, 21.6% (130/602) of nests did not contain the "full modal clutch size of four." The average clutch size for the 602 nests was 3.72 eggs (20+1888+270+50+11 eggs/602 nests). With over 20% of the plover nests in 2006 not containing four eggs and an average clutch size of 3.72 eggs per nest, the use of full modal clutch size of four eggs to estimate egg destruction will not provide for an accurate estimate.

Since that is what is called for in the BiOp Amendment, the results are shown based on that calculation. However, it should be noted that it is more accurate to list the eggs as the maximum possible rather than as the estimated number of eggs.

Nest fates are as follows: 1) Flooded (Non-Corps Operations) – 3 nests, 12 eggs known, 12 eggs maximum: These nests were lost to rising river levels as a result of rain storms in the area; 2) Flooded (Corps Operations) – 40 nests, 119 eggs known, 150 eggs maximum: These nests were lost due to Corps operations on Lakes Sakakawea and Oahe and operations below Garrison and Gavins Point Dams; 3) Weather – 46 nests, 140 eggs known and 171 eggs maximum: These are nests lost to weather events, such as rain, hail, and wind; 4) Predation – 48 nests, 164 eggs known, 180 eggs maximum: Predators include mink, raccoons, coyotes, owls, gulls, crows, and other mammalian and avian species; 5) Human Disturbance – 6 nests, 21 eggs known, 23 eggs maximum: Four nests were lost on Lake Sakakawea, one on the Garrison River, and one on Lake Oahe; 6) Human Disturbance Researcher – 1 nest, 4 eggs known, 4 eggs maximum: One nest was lost on the Gavins Point Segment; 7) Bank Erosion – 6 nests, 26 eggs known, 26 eggs maximum: These nests were lost when the river eroded away the part of the sandbar where the nest was located; 8) Livestock – 6 nests, 23 eggs known, 24 eggs maximum: These nests were lost when cattle stepped on the nests; 9) Wildlife – 2 nests, 5 eggs known, 8 eggs maximum. The eggs were destroyed by geese; 9) Destroyed No Evidence – 80 nests, 229 eggs known, 300 eggs maximum: These were nests that were destroyed before the eggs could have hatched but for which no cause could be determined by the survey crew; 10) Fate Undetermined – 65 nests, 240 eggs known, 240 eggs maximum: In this category the incubation stage was far enough along whereby the eggs could have hatched between site visits. Therefore, the clutch was already complete and no more eggs would have been laid between site visits; 11) Abandoned – 31 nests, 79 eggs known, 79 eggs maximum: These are nests that were abandoned by the adults; 12) Non-viable Eggs – 4 nests, 16 eggs known, 16 eggs maximum: These were nests in which the eggs were not viable, but were still incubated by the adults.

RPM 2.2. Adult and Chick Mortality

Survey crews were instructed to attempt to determine a cause of death for piping plover adults and chicks found on site. If a cause of death could not be determined and the specimen was not decayed, the specimen was then sent to NWHC for analysis. Six adult and seven chick remains were found in 2006.

For the six adults, two were from the Fort Randall River Segment, three were from Lake Oahe, and one was from Lake Sakakawea. The two from Fort Randall were found on a sandbar at RM 870.2 and both were predated. The one from Lake Sakakawea was found in the West Totten area just off of the old road bed for Highway 83. It had also been predated. The three plover adults lost on Lake Oahe all came from the shoreline north of Mission Creek Bay. The predated remains of one plover was found inside of a cage used to protect the nest from predators. A second carcass was also found inside a cage, but was too decomposed to determine the cause of death. The crew did note that the top of the cage was partly bent inward as if some animal had tried to get in the cage. The third plover died when it tried to fly out of a predator cage. The Oahe crew theorized that the plover was spooked as they approached on ATVs to conduct the survey. The plover was found enmeshed in the cage about ten inches off the ground and was bleeding. It appeared to the crew that the plover had died from a broken neck.

For the plover chicks, one of the seven was forwarded to the lab. This plover chick was from a small sandbar at RM 781.4 on the Gavins Point River Segment. The chick was between 20-24 days in age and was being tracked by the Virginia Tech research team. The researchers documented the chick had been losing weight before its death. Two least tern chicks that were found dead three days later at this site were found to have died from the West Nile virus, but lab results for this chick have not come back from the lab in time for results to be included in this report.

Of the six that were not forwarded to the lab, two were one to two days old chicks found at RM 770.0 and RM 781.4. The cause of death was could not be determined and the chicks were too decomposed to be sent to the lab. The other four chicks were one to two days old brood mates from nest 063246 at the Red Mike area of Lake Sakakawea. These chicks were stepped on by persons unknown. The crew noted that there were numerous footprints around the nest bowl and that the footprints led back to all terrain vehicle tracks.

Photograph 11. Plover Chicks Killed at the Red Mike Area of Lake Sakakawea

RPM 3. The Corps shall coordinate regularly with the U.S. Fish & Wildlife Service to ensure that operations minimize take.

From May through August 2006, the Corps Water Management Division and Threatened & Endangered Species Section held weekly conference calls with the Service, North Dakota and Kansas Ecological Services offices to apprise them of the status of water operations and piping plover nest and chick status on the Missouri and Kansas Rivers. Service personnel at the Ecological Services offices in Montana, North Dakota, South Dakota, Nebraska, Kansas, and Missouri had access to the Corps Threatened and Endangered Species Data Management System (TESDMS), whereby they could track piping plover nest and chick status via the Internet. Nests and sites that were considered at risk were highlighted in a report in the TESDMS. Corps and Service elements used the conference calls and the TESDMS to coordinate actions to minimize the take of piping plovers on the Missouri River.

RPM 4. The Corps shall collaborate with the Service … to develop criteria and procedures for the moving of eggs and chicks …

In 2006, ten piping plover nests and ten plover chicks were moved or raised to prevent their loss from flooding. Seven nests were moved to a higher location. This included two on Lake Sakakawea, two on the Garrison River, one on the Fort Randall River, and two on the Gavins Point River Segments. Only one of the seven was subsequently successful. Of the other six, one was flooded, two were lost to weather events, one was destroyed by an undetermined cause, and two were abandoned. Three nests were raised, one on Lake Oahe and two on the Gavins Point River Segment. Of these, one was successful, one was abandoned, and one was destroyed by wildlife (geese stepping on the eggs). Ten plover chicks, six 6-10 days old and four 20-24 days old, were moved on July 21, 2006 from a small sandbar at RM 804.6 to a much larger island at RM 804.5. The move was done because it was determined that increased releases out of Gavins Point Dam would eventually inundate the sandbar. By August 1, the sandbar was underwater. On subsequent visits to RM 804.5, none of the chicks were seen, but older chicks were assumed to have fledged.

RPM 5. The Corps shall implement public information and education programs to increase public awareness to reduce take of nesting piping plovers

RPM 5.2. Public Relations

Outreach efforts in 2006 included presentations before civic organizations, schools, environmental groups, at campfire programs, the writing of articles for area newspapers, and the distribution of the "Missouri River Species at Risk" brochure to area businesses and the public.

RPM 5.3. Posting of Piping Plover Nesting Areas

To deter human disturbance and increase awareness of endangered species, restriction signs and spacer stakes with orange twine were placed around piping plover nesting sites. The signs, stakes, and twine created a "psychological barrier" that delineated the nesting sites for the public. Listed below are the sites where restrictions were posted.

Lake Sakakawea: During the 2006 season, more preemptive measures were taken to deter infractions on Corps land. "No off road vehicles" signs were placed at Tobacco Garden (RM 1511) and Red Mike (RM 1510) and a fence was installed at Little Egypt recreation area to help discourage off road vehicles. In addition to the signs and fence, a seasonal ranger was assigned to patrol shoreline areas, including endangered species habitat to deter off-road vehicle use. The ranger issued fourteen citations, 125-150 verbal warnings, one written warning, and two courtesy warnings during the summer. One of the citations involved a man using a tractor to pull his boat and trailer to the shore through the piping plover nesting area at Red Mike. The man was found guilty by the federal magistrate and was ordered to pay a fine of $160.

Missouri River below Garrison Dam: Restriction signs were placed around nesting sites on the sandbar at Heskett (RM 1319.5) and Eagle's Nest (RM 1308.5).

Lake Oahe: Restriction signs were placed around nesting sites at State Line (RM 1232.0), Vander Laan (RM 1225.0), Old Railroad Grade (RM 1199.0), Blue Blanket (RM 1189.0), Okobojo Creek (RM 1089.5), and at Peoria Flat (RM 1083.0).

Missouri River below Fort Randall Dam: Sandbars at RMs 870.2, 866.5, and 854.0 were fenced and signed.

Missouri River below Gavins Point Dam: Restriction signs and orange twine fencing were placed around nesting sites on sandbars at RMs 808.2, 804.6, 804.5, 802.5, 802.1, 801.3, 801.1, 795.9, 795.5, 795.3, 791.5, 788.5, 770.2, 770.1, 770.0, 761.3, 756.6, and 755.0. In addition to Corps restriction signs, a private landowner used yellow police barricade tape at RM 801.3 to delineate the piping plover nesting area.

Protection of piping plover nesting sites was coordinated with law enforcement officers from the South Dakota Game, Fish & Parks Department. Officers from this agency conducted deterrence patrols throughout the nesting season on the Fort Randall and Gavins Point Segments.

RPM 6. The Corps shall evaluate and implement actions to reduce predation on piping plover nests, chicks and adults

Wire mesh cages were used in 2006 to protect piping plover nests from mammalian and avian predators. The cages consist of three feet by three feet by three feet wire mesh containing two-by-four-inch openings (See Photograph 12). The cages are placed over the plover nest and anchored into the substrate with metal stakes at the four corners. After placing the cage, the surveyors retreat and watch the cage to ensure that the plover returns to the nest inside the cage. If the plover refuses to enter the cage, the cage is removed. When a nest is terminated the cage is removed.

Photograph 12. Gavins Point Crew installing a Plover Cage

As a general rule, cages were placed over plover nests located on river segments, but for nests on the reservoirs it is left to the judgment of the crew whether or not to place cages. The rationale for not placing cages over nests on reservoirs is that most plover nests on reservoirs are in remote, spread out locations and may not be subject to predatory pressure.

In 2006, 46.4% (329 out of 708) of plover nests were caged. Of the nests that were caged, 207 were successful for a nest success of 62.9%. Nest losses for caged nests are as follows: flooding – 9, weather – 10, predator – 25, bank erosion – 6, human disturbance – 2, livestock – 0, wildlife – 0, destroyed no evidence – 18, fate undetermined – 34, abandoned – 15, and non-viable eggs – 3. For the 379 plover nests that were not caged, 163 were successful for a nest success of 43.0%. Nest losses for nests that were not caged are as follows: flooded – 34, weather – 36, predator – 22, bank erosion – 0, human disturbance – 5, livestock – 6, wildlife – 2, destroyed no evidence – 63, fate undetermined – 31, abandoned – 16 and non-viable eggs – 1. The 52 plover broods found on the Missouri River in 2006 that were not associated with any nest were not included with the non-caged plover nests.

In 2006, plover nests that were caged were much more successful than plover nests that were not caged (62.9% vs. 43.0%). However, this was not due to the actual purpose of caging a nest – to prevent predation. The percentage of plover nests lost due to predation was actually higher for caged nests than for non-caged nests – 7.6 % (25/329) vs. 5.8% (22/379). This conundrum can be explained by the appearance of a "smart predator" along the shore of Lake Oahe in 2006. A "smart predator" is one that determines that something delectable (plover eggs and possibly an adult) is inside the cage and, therefore, targets the cage while hunting. On June 8, along the shore of Lake Oahe north of Mission Creek Bay, there were 26 caged plover nests. The crew noted that one previously caged plover nest had been destroyed by a predator. When the crew returned for the next site visit on June 15, they found that seventeen of the caged nests had

been destroyed by a predator. For many of the nests, the predator had dug under the cage to get to the eggs. From tracks in the vicinity of the cages, the crew believed the predator to be a coyote. The crew removed the cages from the surviving nine nests. Of these nine nests, five eventually were successful, three had an undetermined fate, and one was subsequently abandoned. This is believed to be the first case of a "smart predator" for a Missouri River site. Despite the probable presence of the smart predator on Lake Oahe, there was no trapping or removal of predators to protect piping plovers on the Missouri River system in 2006.

RPM 8. The Corps shall develop and implement a program to monitor and evaluate the effectiveness of created sandbars as nesting habitat for piping plovers.

Unlike the least tern RPM 4, which requires the Corps to monitor both created and restored habitat, this RPM requires the Corps to monitor and evaluate the effectiveness only of created habitats. Because restored habitat is an important part of the Corps adaptive management for piping plover habitat, restored habitat is also included with created habitat in this section.

The Corps monitored the created and restored sandbars below Gavins Point Dam as a regular part of the productivity monitoring on the Missouri River. In addition to these habitat types, there were natural sites where no habitat restoration work was done prior to the 2006 nesting season and low releases sites that were used by the plovers in 2005 and were still, but to a lesser degree, available to the plovers in 2006. Refer to the least tern RPM 4 on page 33 for a more thorough description of these habitats.

Nest Success by Habitat Type on the Gavins Point Segment in 2006

Figure 41 shows the habitat type, the number of nests, the number of successful nests, the number of nests that were not successful, the number of nests where the fate was not determined, the percent successful nests for the habitat type, and the percent of nests in the habitat type to the total number of nests in the segment. Successful is defined as a nest where at least one egg hatched; not successful is defined as a nest that was destroyed (flooding, weather, predation, etc.) or was abandoned; not determined is defined a nest in which the egg incubation was far enough along so that the eggs could have hatched between site visits, however, the crew could find no evidence of egg hatching or nest destruction on the subsequent nest visit.

Figure 41. Piping Plover Nest Success by Habitat Type – Gavins Point Segment 2006

Habitat Type	Total	Successful	Not Successful	Not Determined	% Successful	% of Total Nests
Created	116	81	28	7	69.8	56.3
Low Releases	29	14	15	0	48.3	14.1
Natural	35	10	25	0	28.6	17.0
Spray	7	5	2	0	71.4	3.3
Spray (N)	6	4	1	1	66.7	2.9
Spray & Mow	9	2	7	0	22.2	4.4
Spray & Mow (N)	4	0	4	0	0.0	1.9
Total	206	116	82	8	56.3	100.0

Figure 41 shows the created sites had more than half of the nests (56.3%) on the Gavins Point Segment. If one considered the natural sites, the nests that were in natural areas of spray sites and the nests that were in natural areas of spray and mowed sites as the same habitat type, then these combined categories had the second highest number of nests at 21.8% (45/206). The low releases sites had the next highest number of

nests with 14.1% (29/206) of all nests. The spray and mow sites made up 4.4% of all the nests and the spray sites had the remaining 3.3% of the nests.

Though small in nest numbers, the spray sites had the highest nest success rate with 71.4%. Second, with a much higher number of nests, were the created sites at 69.8% (81/118). The low releases sites had a nest success just under 50% (14/29). The combined natural sites had a nest success of 31.1% (10/45). The least successful sites for nests were the spray and mow sites with 22.2% (2/9). Figure 42 compares the total number of nests, successful nests, and nest success by habitat type between 2005 and 2006. Natural sites include nests that were in natural (non-sprayed parts) of the spray and spray and mow sites.

Figure 42. Piping Plovers Nest Success by Habitat Type 2005-2006

Habitat Type	**2005 Total Nests**	**2005 Successful Nests**	**2005 % Successful**	**2006 Total Nests**	**2006 Successful Nests**	**2006 % Successful**
Created	77	55	71.4	116	81	69.8
Low Releases	20	14	70.0	29	14	48.3
Natural*	87	52	60.0	45	14	31.1
Spray	0	0	0.0	7	5	71.4
Spray & Mow	20	14	70.0	9	2	22.2
Total	204	135	66.2	206	116	56.3

Figure 42 shows that there was a 50.6% (116/77) increase in the number of nests on the created sites in 2006 compared to 2005 and both years had comparable nest successes of around 70%. On the low releases sites, there was also an increase in the number nests of 45% (29/20) despite the fact that these sites were smaller due to the increase in releases (25,000 cfs in 2006 and 21,500 cfs in 2005). However, the nest success declined between the two years. The number of nests at natural sites and the success of these nests declined between 2005 and 2006. The decline in the number of nests may be partially explained by the fact several of the natural sites in 2005 were sprayed with herbicide prior to the 2006 nesting season and became spray sites. Spray sites saw an increase in plover nests from 2005 to 2006. However, the number of nests and nest success declined on the spray and mow sites from 2005 to 2006.

It is important to determine if the rehabilitation measures (spray, spray and mowing) work. Figure 43 below examines plover nest use on sandbars that were both sprayed with herbicide and the dead vegetation was mowed down prior to the 2006 nesting season.

Figure 43. Piping Plover Nests Natural vs. Spray and Mow

	Natural		**Spray and Mow**	
River Mile	**Years Used by Plovers**	**#Nests/# Successful**	**Year Work Performed**	**2006 Use Nests/Hatched**
801.1 (a portion)	Never	-	2006	4/0
781.5	1998-2005	11/8	2005	1/1
759.2	2002-2004	8/6	2006	0/0
757.2	1999, 2001-03	1/0	2006	0/0
756.8	2002, 2004	1/1	2006	0/0
756.6	1998-2005	9/6	2005	4/1

On the spray and mow sites, there were four plover nests on a sandbar at RM 801.1, a site not previously used by the plovers; however, none of the nests were successful. At RM 781.5, the plovers were very successful in 2005, but like the terns, with the exception of one nest, they abandoned the sandbar in 2006. This could be attributed to growth of herbaceous plants, such as clover, during 2005 that may have made the sandbar unattractive to the birds. Three spray and mow sandbars (RM 759.2, 757.2, and 756.8) had previously hosted plovers, but did not have any nests in 2006. Finally, the sandbar at RM 756.6 again had nesting plovers in 2006, but the numbers and the nest success declined compared to 2005. Unlike the sandbar at RM 781.5, this sandbar received additional mowing prior to the 2006 nesting season. Figure 44 evaluates piping plover nesting on sandbars that were sprayed with herbicide, but were not mowed prior to the 2006 nesting season.

Figure 44. Piping Plover Nests Natural vs. Spray

	Natural		**Spray**	
River Mile	**Years Used by Plovers**	**#Nests/# Successful Last Year Used**	**Year Work Performed**	**2006 Use Nests/Hatched**
801.1(Part)	Never	-	2006	0/0
799.0	1998-2003	1/0	2006	1/1
796.7	1999-2004	2/1	2006	0/0
796.3	1998	1/1	2006	0/0
795.3	1999-2005	4/4	2006	3/3
793.6	2001-2005	4/2	2006	1/0
793.3	2001-2005	5/2	2006	2/2
790.1	1999-2003	1/0	2006	0/0
789.6	2001-2005	1/1	2006	1/0
786.1	2003-2004	1/1	2006	0/0
785.2	Never	-	2006	0/0
784.5	Never	-	2006	0/0
783.0	Never	-	2006	0/0
778.5	2001-2004	5/4	2006	1/0
777.7	1998-2004	1/1	2005	1/1
773.0	2001	2/2	2006	0/0
768.0	1998-2004	2/0	2006	0/0
759.5	Never	-	2006	0/0

Sixteen sites were sprayed (fifteen in 2006 and one in 2005) and were not mowed. Four of the sites (RM 795.3, 793.6, 793.3, and 789.6) had plover nests in 2005 and all four had plover nests in 2006. The number of nests and successful nests at these four sites was down in 2006 (7 nests/5 successful) compared to 2005 (14 nests/9 successful). Eight sites have previously had plover nests, but had no nests in 2005. In 2006, two of these eight sites had plover nests. There was one plover nest at RM 799.0 after an absence of three years and one plover nest at RM 777.7 after an absence of two years. Five of these sites never had any known plover nests between 1998 and 2005 and none of them had any nests in 2006. Excluding the sandbars used by the plovers in 2005, only two of thirteen sandbars that were sprayed had plover nests and in each case this constituted only one nest. The spraying of herbicide to kill vegetation did not open the sandbars to plover nesting.

Plovers nested on three sprayed sandbars, but did not nest in areas that were sprayed. The results for these sandbars are shown in Figure 45.

Figure 45. Plover Nesting in Non-Spray Areas of Spray Sandbars

River Mile	Year Last Used by Plovers	#Nests/# Successful	Year Work Performed	2006 Use Nests/Hatched
797.5	2001, 2003	2/2	2006	1/1
789.6	2005	1/1	2006	2/2
782.5	2003	2/2	2006	1/1

At RM 797.5, there was a plover nest on the sandbar for the first time in three years. The nest was along the shoreline on the north side of the sandbar, not in the sprayed area. At RM 789.6, in 2006, there were two plover nests compared to one in 2005. But like the terns at this site, the plover nested along the shoreline of the sandbar and not in the sprayed area. At RM 782.5, a plover nest was found on the sandbar for the first time in three years, but like the terns at this site, the plovers nested in an area that was free of vegetation in 2005 and did not nest in the sprayed area. Whether the sprayed area made the already vegetation-free area more attractive to the two species is not known.

Nest numbers and nest success are not the only way to measure piping plover use of created and rehabilitated habitat. Adult numbers, fledglings, and fledge ratios measure the productivity of the birds on the sandbars. Figure 46 below shows the 2006 results by habitat type below Gavins Point.

Figure 46. 2006 Gavins Point Piping Plover Success by Habitat Type

Habitat Type	Adults	Fledglings	Fledge Ratio
Created	156	90	1.15
Low Releases	41	17	0.83
Natural	54	6	0.22
Spray	40	7	0.35
Spray & Mow	18	1	0.11
Total	**309**	**121**	**0.78**

Figure 46 shows that the created sites had little more than half of the piping plovers on the Gavins Point Segment (50.4%) but almost three quarters (74.3%) of all the fledglings. The other habitat types varied from 5.8% of the adults (spray and mow) to 17.5% (natural). The created sites had the best fledge ratio of the habitat types at 1.15 fledglings per adult pair, but none of the habitat types exceeded the BiOp goal of 1.22 and the fledge ratios for the natural, spray, and spray and mow sites were especially poor. The 2006 results are in marked contrast to the 2005 results which are show in Figure 47 below.

Figure 47. 2005 Gavins Point Piping Plover Success by Habitat Type

Habitat Type	Adults	Fledglings	Fledge Ratio
Created	136	138	2.03
Low Releases	42	54	2.57
Natural	130	121	1.86
Spray	2	0	0.00
Spray & Mow	30	22	1.47
Total	**340**	**335**	**1.97**

Figure 48 below compares the numerical and percent increase or decrease between 2005 and 2006 by habitat type. It shows that there were moderate increases in the number of adults for the created and spray sites and a substantial decrease on natural sites. The increase in adults on the created sites is probably

related to those sites having the best habitat in terms of size and lack of vegetation. The increase in plover adults on spray sites and the decrease on natural sites can be partially explained by the conversion of several natural sandbars to spray sandbars. Fledgling numbers were down for all habitat types except for spray sites. Natural and spray and mow sites saw a decline in fledgling numbers by 95%, the low releases sites saw a decline of nearly 70%, and the created sites saw a decline of more than a third. The big decline in fledglings on the natural sites most likely cannot be attributed to the conversion of some of these sites to spray sites as the number of fledglings declined by 115 while the spray sites increased by only seven. The decline in fledglings on low releases sites can be attributed to a lack of habitat due to higher releases out of Gavins Point Dam in 2006. The large decline of fledglings on the spray and mow sites for the plovers can be attributed to the abandonment of the sandbar at RM 781.5 where the number of fledglings went from eighteen in 2005 to one in 2006. Given the high nest success on the created sites in 2006, some other factor must account for the lower number of chicks graduating from hatchling to fledgling. None of these sites experienced catastrophic rain or hail events in 2006, so, weather can be eliminated as a possible cause. The most likely culprit was the predation of chicks.

Figure 48. Piping Plover Adults, Fledglings and Fledge Ratios by Habitat Type 2005-2006

Habitat Type	**Number of Adults**	**% Adults**	**Number of Fledglings**	**% Fledglings**	**Fledge Ratio Difference**
Created	+20	+14.7	-48	-34.8	-0.88
Low Releases	-1	-2.3	-37	-68.5	-1.74
Natural	-76	-58.5	-115	-95.0	-1.64
Spray	+38	+1900.0	+7	-	+0.35
Spray & Mow	-12	-40.0	-21	-95.5	1.36
Total	**-21**	**-6.2**	**-214**	**-63.9**	**-1.19**

Due to the importance of the created sites in achieving fledge ratio goals in 2005 and the poor performance in 2006 relative to 2005, the sites will be examined individually to determine if there was a difference in performance. Figure 49 below examines the created sites to establish if there were significant differences between adult, fledgling, and fledge ratio numbers between 2005 and 2006.

Figure 49. Piping Plover Adults, Fledglings and Fledge Ratios on Created Sites, 2005-2006

Site	**2005 Adults**	**2006 Adults**	**2005 Fledglings**	**2006 Fledglings**	**2005 Fledge Ratio**	**2006 Fledge Ratio**
RM 770*	60	80	76	30	2.53	0.75
RM 761.3	42	68	56	55	2.67	1.62
Ponca**	32	8	6	5	0.50	1.25

*Includes the three sandbars at RM 770.2, 770.1, and 770.0
**Includes the two sandbars at RM 755.0 and 754.5

Figure 49 shows that there were substantial increases in plover adults at the RM 770 complex (33.3%) and at RM 761.3 (61.9%) and substantial decline at the Ponca complex (75.0%). All three sites saw declines in fledgling numbers with the RM 770 complex having a substantial decline of 60.5%, RM 761.3 having a very minor decline of 1.8%, and the Ponca complex declining by 16.7%. For the RM 770 complex, this meant a large decline in the fledge ratio of 1.78, down to 0.75 fledglings per adult pair. At RM 761.3, the fledge ratio also has a substantial decline of 1.05, but the 2006 fledge ratio was still 0.40 above the BiOp goal of 1.22. The Ponca complex actually saw a gain of 0.75 in the fledge ratio from 2005 to 2006, but the number of plovers using this complex was insignificant compared to the other two sites.

The large decline in adult and fledgling numbers that occurred on the natural sites in 2006 needs be further examined as several of the 2005 sites were sprayed with herbicide to enhance the habitat for plovers. Figure 50 below compares differences between sites that were natural in 2005 and became sprayed in 2006 and sites that were natural in both 2005 and 2006.

Figure 50. Piping Plover Adults & Fledglings Natural 2005/Spray 2006 vs. Natural in both 2005 & 2006

Type	**2005/2006 Adults**	**2005/2006 Fledglings**	**2005/2006 Fledge Ratios**
Natural 2005/Spray 2006	60/54	60/7	2.00/0.26
Natural 2005/Natural 2006	70/56	61/6	1.74/0.21

Figure 50 shows that there was a slight decline in adults, 10%, on sites that were natural in 2005 and spray in 2006. However, there was 88.3% decline in fledglings (60 to 7) on these sites between the two years. Obviously spraying these sandbars with herbicide to kill vegetation did not improve productivity on the bars. Still, the spraying of the sandbars may not have been the cause of the fledgling crash. The sandbars that were natural in 2005 and remained natural in 2006 had similar number of adults (12.9% decline from 2005 to 2006), but, like the natural/spray sites, there was similar significant decline in piping plover fledglings going from 61 to 6 for a drop of 89.3%. Because the terns experienced a similar decline on these habitat types, some factor other than vegetation modification was at play for the decline of fledglings from both species in 2006.

Habitat Rehabilitation on Lewis & Clark Lake

In the fall of 2005, sandbars at RM 842.2, 839.5, 839.0, 838.0, and 837.0 were sprayed with herbicide. None of the sites was mowed to remove dead plant material. All of these sites have previously hosted piping plover nests. In 2006, there were only three plover nests on Lewis & Clark Lake, two at RM 839.0 and one at RM 838.0. The spraying of these sandbars did attract the birds back in 2006. Figure 51 below shows piping plover use of the sandbars in the past and the number of nests and nest success the last year the site was used by the plovers.

Figure 51. Piping Plover Nests Natural vs. Spray on Lewis & Clark Lake

	Natural		**Spray**	
River Mile	**Years Used by Plovers**	**#Nests/# Successful Last Year Used**	**Year Work Performed**	**2006 Use Nests/Hatched**
842.2	1998-2001	3/2	2005	0/0
839.5	1999	2/0	2005	0/0
839.0	1998-2000	1/0	2005	2/1
838.0	1998-2005	3/0	2005	1/1
837.0	1998-2000	2/1	2005	0/0

Figure 51 shows, with the exception of the sandbar at RM 838.0, that plovers had not used the sandbars from five to seven years. The spraying of the sandbars in the fall of 2005 did not induce the plovers to return to the sandbars at RMs 842.2, 839.5 or 837.0. However, after an absence of six years, there were two piping plover nests at 839.0. At RM 838.0, there was one successful nest in 2006 compared with three unsuccessful nests in 2005.

In comparing adults and fledglings between 2005 and 2006 on the spray sites, in 2005 there were no adults or fledglings at RM 839.0 and two adults and no fledglings at RM 838.0. In 2006, at RM 839.0, there were

two adults and one fledgling and two adults and no fledglings at RM 838.0. Whether this increase of one fledgling from 2005 to 2006 can be attributed to vegetation modification is open to debate, but, nevertheless, the plovers had not used RM 839.0 for six years prior to the spraying.

Habitat Rehabilitation on the Fort Randall River Segment

In the fall of 2005, sandbars at RM 870.2, 869.5 (a portion), 866.7, 866.5, 863.7, 854.7, 854.0, 851.7, 848.5, and 846.5 were sprayed with herbicide. None of the sites were mowed to remove dead plant material. Figure 52 below examines the nesting success by habitat on Fort Randall in 2006.

Figure 52. Piping Plover Nest Success by Habitat Type – Fort Randall Segment 2006

Habitat Type	Total	Successful	Not Successful	Not Determined	% Successful	% of Total
Natural	1	0	1	0	0.0	5.0
Spray	18	8	8	2	44.4	90.0
Spray (N)	1	1	0	0	100.0	5.0
Total	20	9	9	2	45.0	100.0

Plovers nested on eight sites on Fort Randall in 2006: RM 875.0, 870.2, 869.5, 866.7, 866.5, 863.7, 854.0, and 851.7. Of these sites, all but RM 875.0 were sprayed in 2005. However, one of the five nests at RM 851.7 was in an area that was not sprayed. Figure 52 shows that 90% of the plover nests were on spray sites with 44.4% being successful. The other two nests were on natural or natural areas of spray sites and, of these, 50.0% were successful. Figure 53 below compares total number of nests, successful nests, and nest success by habitat type between 2005 and 2006.

Figure 53. Piping Plover Nest Success by Habitat Type – Fort Randall Segment 2005-2006

Habitat Type	2005 Total Nests	2005 Successful Nests	2005 % Successful	2006 Total Nests	2006 Successful Nests	2006 % Successful
Natural	21	15	71.4	2	1	50.0
Spray	0	0	0.0	18	8	44.4
Total	**21**	**15**	**71.4**	**20**	**9**	**45.0**

Figure 53 shows that there were comparable numbers of plover nests between 2005 (21) and 2006 (20), but that nest success in 2005 was much higher for natural sites, 71.4%, than in 2006 for the spray sites , 44.4%.

Figure 54 below examines plover use of sandbars that were natural in 2005 and were then converted to spray sandbars for the 2006 nesting season. Figure 53 shows that plovers nested on seven of the ten sites that were sprayed in the fall of 2005. All seven of these sites had plover nests in 2005. Plovers did not nest at RM 854.7 where there was one nest in 2005 and they did not nest at RM 848.5 where the last nesting occurred in 2002. They also did not nest at RM 846.5, where plovers were never known to have nested. In 2005, the sandbars that would be sprayed in the fall of that year had nineteen nests, thirteen of which were successful (68.4%). In 2006, these sandbars had eighteen nests, eight of which were successful (44.4%).

To measure the effectiveness of rehabilitated habitat on the Fort Randall Segment, adult, fledgling, and fledge ratios need to be examined. In 2006, there were 37 adults, 7 fledglings, and a fledge ratio of 0.38 fledglings per adult pair for piping plovers on Fort Randall. By habitat type, the numbers are as follows:

natural – 4 adults, 0 fledglings, 0.00 fledge ratio; and spray – 33 adults, 7 fledglings, 0.42 fledge ratio. At RM 851.7, a spray site, of the eight adults at this site, two were associated with a nest in a natural area and six were associated with nests in spray areas.

Figure 54. Piping Plover Nests Natural vs. Spray

River Mile	Year Last Used by Plovers	#Nests/# Successful	Year Work Performed	2006 Use Nests/Hatched
870.2	2005	4/2	2005	3/2
869.5 (Portion)	2005	4/3	2005	3/2
866.7	2005	1/1	2005	2/0
866.5	2005	1/1	2005	2/1
863.7	2005	2/1	2005	2/1
854.7	2005	1/1	2005	0/0
854.0	2005	1/1	2005	2/1
851.7 (Spray)	2005	5/3	2005	4/1
851.7 (Natural)	2005	0/0	2005	1/1
848.5	2002	6/0	2005	0/0
846.5	Never	-	2005	0/0

In 2006, the plovers were more numerous on the spray sites compared to the natural sites (33 to 4) and raised more fledglings (7 to 0), but because many of the spray sites in 2006 were natural sites in 2005, the two years need to be compared to determine if there was a difference in productivity that could be attributed to the management action. Figure 55 below compares the two years.

Figure 55. Piping Plover Natural vs. Spray Sites 2005 – 2006

Site	2005 Adults	2006 Adults	2005 Fledge	2006 Fledge	2005 Fledge Ratio	2006 Fledge Ratio
870.2	6	5	0	1	0.00	0.40
869.5	6	10	0	3	0.00	0.60
866.7	2	3	0	0	0.00	0.00
866.5	4	5	4	0	2.00	0.00
863.7	4	2	0	0	0.00	0.00
854.7	2	0	1	0	1.00	0.00
854.0	2	2	2	3	2.00	3.00
851.7	8	6	3	0	0.75	0.00
Total	**34**	**33**	**10**	**7**	**0.59**	**0.42**

Figure 55 shows that there were nearly identical numbers of plover adults between the two years, so, the spraying did not have a dramatic effect on those numbers. The plovers were slightly more productive in 2005 with ten fledglings and a fledge ratio of 0.59 compared to 2006's seven fledglings with a fledge ratio of 0.42. Three sites (RM 866.5, 854.7, and 851.7) produced fledglings in 2005, but none in 2006. Conversely, two sites (RM 870.2 and 869.5) produced fledglings in 2006, but not in 2005. Only one site (RM 854.0) produced fledglings in both years and two sites (RM 866.7 and 863.7) did not produce fledglings in either year. Overall, no definite conclusions can be drawn about the effectiveness that spraying had on the sandbars for piping plover use on the Fort Randall Segment.

Habitat Rehabilitation on the Lake Oahe Segment

In the fall of 2004, the Oahe Project maintenance crew modified an island (Fish Gut Islands Group) in the Cheyenne River arm of Lake Oahe by leveling it and placing gravel over it. In 2005, there was one unsuccessful piping plover nest at this site. In 2006, the site was not used by least terns or piping plovers.

Virginia Polytechnic Institute Piping Plover Study

In addition to monitoring and evaluation efforts by Corps personnel, the Corps has contracted with the Virginia Polytechnic Institute to conduct a three year PhD study to investigate "Factors Affecting Piping Plover Nesting Density and Population Numbers on the Missouri River, on Created and Natural Bars." In 2006, researcher Dan Catlin completed the second field season on the Gavins Point Segment.
The objectives of this study include:

1) To compare nest density, survival reproductive output, immigration and emigration, and foraging/staging areas among artificially created and naturally occurring sandbars, evaluating the effectiveness of artificial habitat.

2) To estimate survival rates for both adult and juvenile piping plovers nesting below the Gavins Point Dam and determine the factors that affect those rates.

3) To estimate piping plover reproductive output below the Gavins Point Dam and to determine the factors affecting productivity.

4) To estimate nest density and to determine the factors affecting nest density below the Gavins Point Dam.

5) To locate and describe off river foraging by adults and staging areas by adults and juveniles.

6) To establish an adaptive management model of survival and productivity for piping plovers nesting on the Missouri River.

7) To establish a preliminary model of movement of adult and juvenile plovers among Missouri River sub-populations.

II.D Other Research Activities

The following activities took place in 2006 that are not covered under RPAs, RPMs, and Conservation Measures, but, nevertheless, involved least terns and piping plovers on the Missouri River.

International Piping Plover Adult Census

Every five years, beginning in 1991, an effort is undertaken to conduct a census of all piping plovers on the wintering grounds including the Atlantic Coast from North Carolina to Florida, the Gulf Coast from Florida to Mexico, Caribbean Islands, and the Bahamas. This is followed by a census of all piping plover adults on the breeding grounds including the Atlantic Coast from North Carolina to Newfoundland, the Great Lakes, and the Northern Great Plains including Kansas, Colorado, Nebraska, South Dakota, North Dakota, Montana, Minnesota, Manitoba, Saskatchewan, and Alberta. The year 2006 would see the completion of the fourth International Piping Plover Adult Census.

From January 23 - 26, 2006, Greg Pavelka and Coral Huber of the Corps (Omaha District) Threatened and Endangered Species Section assisted personnel of the Louisiana Department of Wildlife and Fisheries in conducting the winter census on the Isles Dernieres located southwest of Terrebonne Bay, Louisiana. Numerous piping plovers were observed and seemed to have weathered Hurricanes Katrina and Rita, which had struck glancing blows at the islands in the fall of 2005.

Normally, on the Missouri River, the least tern and piping plover adult census is conducted during the last two weeks in June, by which time the terns have settled on the nesting grounds. To conform to the time frame of the International Piping Plover Adult Census, the census for the plovers was moved up two weeks and was conducted from June 3-16, 2006. The adult census for least terns was conducted during the normal census time period, from June 18 through July 1, 2006.

The international census, in addition to requiring the crews to conduct censuses at different time periods for the two species, included other tasks above and beyond the normal census done by the survey crews. This included filling out census forms developed by the international census coordinator, mapping of all piping plover adults and habitat locations, filling out surveyor experience forms, and conducting detectability surveys. The detectability survey consisted of a second adult census at sites randomly selected by a computer program based on known piping plover sites from the 2001 international census. The second survey was to be done at the site within ten days of the first census.

The census forms, surveyor experience forms, maps, and data summary sheets were compiled by the Corps (Omaha District) Threatened and Endangered Species Section and forwarded to international census coordinator at the U.S. Geological Survey's Forest and Rangeland Ecosystem Science Center in Corvallis, Oregon in September 2006. Results of the 2006 international census are expected in early 2007.

Piping Plover Band Sightings

Piping plovers have been banded in various locales across their range for research purposes. These research purposes include aging adults and chicks, adult and chick survival through the years, identification of breeding partners, measuring productivity of adults, and to determine migration patterns and wintering grounds sites and usage.

During training, Corps personnel are instructed to check the legs of piping plovers to determine if the bird is banded. Banded birds are then reported in the field journal with a description of the type and color of the band(s) and the location of the band(s) on the bird's leg(s).

There are three types of banded piping plovers associated with the Missouri River: 1) Green Flag – This is a regional marker used for the Virginia Polytechnic Institute study of piping plovers below Gavins Point Dam. Sightings of these plovers are not recorded in this report unless they were observed on the Missouri River outside of the study area. This did not occur in 2006; 2) Light Blue Flag – This is a regional marker for piping plovers that were captive reared by the Corps of Engineers and then released into the wild. Captive rearing occurred from 1995 through 2002. The majority of these plovers were released on the Missouri River below Gavins Point Dam and on the Niobrara River upstream from its confluence with the Missouri, but some of the plovers were also released at the Bowdoin National Wildlife Refuge in eastern Montana, on the Missouri River below Garrison Dam, on Lake Oahe, on the Missouri River below Fort Randall Dam, and on the Platte River in eastern Nebraska; and 3) All other Banded Plovers – This would include plovers banded by other researchers.

Light Blue Flag Observations

Fort Randall Segment:

RM 867.0: a plover with a light blue flag on the lower right leg and a metal band on the upper left leg was observed on May 15 and 22. The plover was never associated with a nest. The location of the flag is unusual in that the flag was always attached to the bird's upper leg. Evidently the flag slipped down past the knee joint. Of further interest, a birder reported seeing a piping plover with a light blue flag on the lower right leg at Three Rooker Bar, a sandbar along the Florida Gulf Coast north of Tampa in 2005. It may be the same bird.

Gavins Point Segment:

RM 808.2: a plover with a light blue flag on its upper right leg was observed here on April 26. This was the first piping plover seen during the 2006 nesting season. The plover was not seen again at this location.

RM 807.3: a plover with a light blue flag on its upper right leg was observed here on May 4, 11, and 26 and on July 7 and 10. This plover was never associated with a nest.

RM 804.6: a plover with a light blue flag on its upper right leg was observed here on May 4. This plover was never associated with a nest.

Several light blue flag plovers were observed and, in some cases, were captured by the VPI crew during the nesting season. Listed below are their sightings and the history of the plovers for which the band number is known.

RM 804.5: A plover with a Service band 1001-20898 was first observed on May 6, 2006. The plover was associated with a nest and was captured. The bird is a 2001 captive reared plover that hatched from an egg that was collected off of Lewis & Clark Lake. The plover was released on August 15, 2001 onto a sandbar at RM 795.3 below Gavins Point Dam.

RM 802.5: a plover with a light blue flag was observed on April 26, 2006.

RM 788.5: a plover with a light blue flag was observed on May 6, 2006. The plover may be the same as the one described below.

RM 788.5: A plover with a Service band 1001-20816 was first observed on May 10, 2006. The plover was associated with a nest and was captured. The bird was a 1999 captive reared plover that hatched from an egg that was collected from Steinke Bay on Lake Sakakawea. The plover was released on July 12, 1999 onto a sandbar at RM 789.0 below Gavins Point Dam.

RM 781.5: A plover with a Service band 1001-20780 was first observed on May 9, 2006. The plover was associated with a nest and was captured. The bird was a 2002 captive reared plover that hatched from an egg that was collected off of the Fort Randall Segment. The plover was released on August 21, 2002 onto a sandbar at RM 795.3 below Gavins Point Dam. (The plover observed by VPI in 2005 on the Gavins Point Segment.)

RM 770.0: A plover with USFWS band 1001-20715 was first seen on April 17, 2006. The plover was associated with a nest and was captured. The plover is a 1998 wild reared plover banded by Robyn Niver as a part of her Master's study on the survivability of captive reared vs. wild reared piping plovers.

RM 770.0: A plover with a light blue flag on the upper right leg and a metal band on the lower left leg was observed on July 14, 2006.

Texas Gulf Coast (wintering grounds) Observations

Bolivar Flats (a barrier island adjacent to Galveston Bay): A light blue flag upper right, metal lower left, observed on January 31, March 17, and September 13, 2006.

Padre Island National Seashore (a barrier island located southeast of Corpus Christi): A light blue flag upper right, metal lower, observed on October 6, 2006.

Sea Rim State Park (shoreline beach located south of Port Arthur): A light blue flag upper right, metal lower, observed on October 24, 2006.

Other Banded Piping Plovers

Lake Sakakawea:

Van Hook Arm Southwest: A plover with a red band on its upper right leg and a green band on its lower left leg was observed here on June 7, 2006. It was associated with Nest 063242. The plover may have been banded by Danielle Le Fer as part of a study of piping plovers on Lake Sakakawea.

Photograph 13. Canadian Piping Plover that nested on the Missouri River below Garrison Dam in 2006

Garrison River:

RM 1374.0: A plover with a black flag on the upper right and an orange over red band combination on the lower right leg and no bands visible on the left leg was observed on June 3, 2006. The plover was seen in the vicinity of Nests 064023 and 064024, but was not observed going to either nest. The plover was not seen again. The black flag is a regional marker used by the Canadian Wildlife Service for plovers banded in Saskatchewan.

RM 1367.5: A plover with a silver band on the lower right leg and a light blue band on the lower left leg was observed on June 4, 2006. The bander is unknown.

RM 1361.0: A plover with a light blue band on the upper right leg was observed on June 4, 2006. The plover was probably banded by Danielle Le Fer as a part of her study of plovers on the Missouri River.

RM 1328.0: A plover with a metal band on the upper right, green over blue bands on the lower right leg, a black flag on the upper left, and a blue band on the lower left leg was associated with a Nest 064200 on May 22, 2006. The plover was captured on the nest on May 25. From the band number, the Canadian Wildlife Service stated that the plover was a female that was banded in the summer of 2005 on the east side of Big Quill Lake, Saskatchewan. The female was associated with a nest that hatched on July 20, 2005 but none of the chicks fledged. Nest 064200 contained a four egg clutch that hatched around June 15, 2006. One chick was known to have fledged from the brood.

Gavins Point River:

RM 777.4: A plover with a yellow band on the lower right leg, a black flag on the upper left, and a light green band on the lower left leg was observed on April 27, 2006 feeding along the shore. The plover was not seen again. The plover was banded by the Canadian Wildlife Service in Saskatchewan.

Interior Least Tern Range Wide Adult Census

As in 2005, the Corps participated in a range wide adult census of the interior population of the least tern. Unlike the international piping plover adult census, the least tern census window was within the time period that the Corps normally conducts the adult census, so, no adjustment was required. As with the international plover census, census forms for the least tern census needed to be filled out by the survey crews. The data was then entered into the least tern data management system that has been developed in a cooperative effort by the Corps and the American Bird Conservancy.

Evaluation of Procedures for Monitoring Numbers and Productivity of Piping Plovers and Least Terns on the Missouri River

The Corps contracted with the USGS's Northern Prairie Wildlife Research Center to evaluate the procedures the Corps uses to monitor the adult numbers and productivity of least terns and piping plovers on the Missouri River. The year 2006 was the second field season for this evaluation. In contrast to 2005, when the monitoring was conducted on the Gavins Point Segment, in 2006, the USGS crew conducted monitoring activities on the Garrison River Segment.

Habitat Selection, Productivity and Estimation of Available Nesting Habitat for Piping Plovers on Lake Sakakawea

The Corps contracted with the U.S. Geological Survey's Northern Prairie Wildlife Research Center to examine piping plover use of Lake Sakakawea. The year 2006 was the first field season for this project. The project has four objectives: 1) examine piping plover nesting habitat selection, 2) determine what characteristics constitute quality nesting habitat for piping plovers on Lake Sakakawea, 3) estimate availability of preferred and quality nesting habitat for piping plovers on Lake Sakakawea, and 4) evaluate and predict effects of varying and rising lake levels on availability of preferred and quality nesting habitat for piping plovers on Lake Sakakawea.

III. ECOSYSTEM

III.A. Bald Eagle Research - Omaha and Kansas City Districts

On February 7, 2006, Kristine Nemec delivered a presentation entitled "Cottonwood Community Delineation" at the Corps Operations Northwestern Division Wildlife Workshop in Omaha, Nebraska.

On May 2, 2006, the Corps held a model development workshop in Yankton, South Dakota for the riparian cottonwood community model in support of bald eagle reasonable and prudent measures (RPMs). The workshop was conducted by Tisa Webb and Kelly Burks-Copes from the Engineering Research and Development Center (ERDC) with assistance from Lisa Rabbe of the Kansas City District and Kristine Nemec of the Omaha District. Meeting attendees were Dr. Carter Johnson, South Dakota State University; Stephen Wilson, National Park Service; Carol Aron, U.S. Fish and Wildlife Service/South Dakota, Game,

Fish and Parks Department; Steve Grube, NRCS Missouri River Futures office; and Steve Rasmussen, Nebraska Forest Service.

The purpose of the meeting was to determine what variables should be included in a riparian cottonwood forest model that can be used to address the three bald eagle RPMs of the biological opinion: 1) map and evaluate current health of cottonwood forests on the Missouri River, 2) develop management plan for cottonwood regeneration, and 3) implement actions to ensure no more than 10% of eagle habitat is lost

The model will initially be used for the 59-mile Missouri National Recreational River (MNRR) between Yankton, South Dakota and Ponca State Park. The model will be developed to include design features that can be used along the Missouri River from the headwaters to St. Louis, Missouri. The team developed a timeline for the project and agreed upon biological, hydrologic, and landscape variables that should be included in the model.

Notes from the meeting can be found at: https://w3.nwo.usace.army.mil/html/pd-e/workshop.html

From August 15-18, 2006, members of the cottonwood team collected field data for the biological component of the model, including data on riparian understory species and tree species composition at four cottonwood forests on public lands along the MNRR. Participants included Dr. Gary Wilson and Dr. Carter Johnson, South Dakota State University; Dr. Mark Dixon, University of South Dakota; Charles Sellmeyer, Jennifer Switzer, Lisa Rabbe, and Kristine Nemec, Corps; and Stephen Wilson and Leslie Farnham, National Park Service. The Kansas City District is working on GIS information for the model and the Omaha District is providing hydrologic information for the model.

IV. Missouri River Basin Water Management

IV.A. 2006 Gavins Point Spring Pulse

The BiOp recommended the implementation of a Gavins Point spring pulse for the benefit of the endangered pallid sturgeon by 2006. Working with the Service, tribes, states, and basin stakeholders, the Corps developed technical criteria for the bimodal spring pulses and, in March 2006, the Master Manual was revised to include spring pulse criteria. The criteria called for a bimodal spring pulse with a small initial pulse in March coinciding with the start of the navigation season and a larger pulse in early to mid-May with the start date dependent on water temperature, potential incidental take of the ESA protected interior least terns and piping plovers, and downstream flow conditions. The criteria for each pulse also included a System storage preclude below which the pulse would not be run.

On March 1, 2006, the System storage was below the preclude value identified in the technical criteria, so, the March pulse was foregone. However, by May 1, System storage had recovered sufficiently to conduct the May pulse. A flow-to-target regulation was used to determine releases from Gavins Point dam from the start of the navigation season to the start of the spring pulse. Based on the May 1st System storage and runoff forecast, the magnitude of the May pulse was set at 9,000 cfs over the existing flow rate at the start of the pulse. The initiation date of the pulse, which the criteria sets at between May 1 and May 19, was delayed until May 13 to allow the water temperature to reach the desired 16° C. Releases were increased from 16,000 cfs on May 12 to 22,000 cfs on May 13 and reached the peak rate of 25,000 cfs on May 14. Releases were maintained at that rate for two days and then were decreased 1,500 cfs/day each of the first two days to meet the 30% reduction over two days criteria. Releases were then incrementally stepped down until they reached the navigation flow support release of 18,500 cfs on May 23. In order to minimize the incidental take of terns and plovers, releases were increased to the planned initial steady release rate (25,000 cfs) twice during the recession limb of the hydrograph, May 19 and May 22, to prevent nesting on low elevation sandbar habitat below Gavins Point Dam.

Approximately 85,000 acre-feet of water were required to conduct the May 2006 spring pulse. This compares to a total release during the period from May 13 to 22 of 450,000 acre-feet, of which 345,000 acre-feet was for downstream purposes including water supply and navigation, 20,000 acre-feet was to prevent nesting on the low elevation sandbar habitat, and 85,000 acre-feet was to conduct the spring pulse.

Water previously stored in Fort Randall and Gavins Point reservoirs was used to conduct the actual pulse. Ultimately, the volume of water required for the pulse comes from the upper three reservoirs when System storage is balanced at the end of the water year. Based on the July 1 storage check, which determines the navigation season length, the navigation season was shortened one additional day due to the spring pulse. This additional day of navigation service shortening conserved about 36,000 acre-feet of water in the System or slightly less than half of the water required for the spring pulse. Thus, the actual decline in System storage due to the pulse was 49,000 acre-feet (85,000-36,000) which is equivalent to about 1 inch in each of the upper three reservoirs.

IV.B. Missouri River Recovery Implementation Committee (MRRIC)

The process for establishment of a MRRIC made up of the full range of basin tribes and stakeholders has made significant progress with direct assistance from the U.S. Institute for Environmental Conflict Resolution. A Federal Working Group (FWG) made up of staff from the numerous federal agencies with programs affecting the Missouri River released a proposed framework for establishing a MRRIC in August of 2006. Open houses and numerous meetings were held throughout the basin to facilitate tribal and public discussion of the proposed framework. With the endorsement of the Missouri River Basin Interagency Roundtable (MRBIR), made up of the federal executives with programs affecting the Missouri River, the FWG is revising the framework document to address the issues raised by basin tribes and stakeholders. Following completion of the framework, drafting and oversight committees made up of tribal members and stakeholders will proceed to develop a charter for the formal MRRIC. The current process provides for convening of the formal MRRIC in late 2007.

IV.C. 2006 Litigation

Denial of Supreme Court Review. On April 24, 2006, the Supreme Court denied the remaining petitions for Supreme Court review arising out of the Missouri River litigation. Four petitions had been submitted. Three of the petitions challenged the 8th Circuit's decisions sustaining the Corps new Master Manual and the Service's BiOp: 1) North Dakota and South Dakota sought to challenge the ruling of the 8th Circuit Court of Appeals stating that the authorization for the Missouri River Main Stem System requires the Army to afford some priority to navigation over other project purposes and that the Corps balancing of water use interests was not arbitrary and capricious; 2) Environmental Defense filed a petition claiming that the court of appeals affirmed the Service's decision about artificial habitat on grounds not made by the agency; and 3) the Nebraska Public Power District filed a cross petition for Supreme Court review, claiming that the Service used the wrong environmental baseline. Previous to these denials of certiorari, the Supreme Court denied a fourth petition for Supreme Court review filed by North Dakota seeking to limit discharges from Lake Sakakawea by the Corps on the grounds that they would lead to a violation of the state's water quality standards. In that action, the Corps successfully argued that the navigation purpose of our project takes precedence over state water quality standards.

State of Missouri. In Re Operation of the Missouri River System, State of Missouri, ex rel. Jeremiah W. (Jay) Nixon v. USACE, Francis J. Harvey, Secretary of the Army and Brigadier General Gregg F. Martin. On May 24, 2006, the State of Missouri filed a new complaint in the District of Minnesota challenging the adequacy of the Corps National Environmental Policy Act (NEPA) compliance for the spring rise. Oral arguments were held on September 21, 2006 and a decision was received on November 2, 2006. The Court held that the Corps had complied with NEPA and awarded summary judgment to the Corps on all counts of Missouri's complaint.

In this litigation, Missouri claimed that the Corps violated NEPA by issuing an EA instead of a supplemental EIS and by not analyzing a full range of alternatives. In reaching his decision, Judge Magnuson reviewed the background leading up to the Corps revision. This included the issuance of the 2004 Master Manual, the efforts of the Corps, Service, and the U.S. Institute for Environmental Conflict Resolution and their professional facilitator, CDR Associates, to develop a regional consensus for the Spring Rise criteria. The Judge referenced the Corps draft Annual Operating Plan (AOP) process which included public meetings, the opportunity for input, and comment on the draft spring rise technical criteria. The Judge noted that the Corps EA and memorandum of decision was not finalized until after the

completion of these processes and a letter from the Service indicating that the Corps preferred alternative met the requirements of the 2003 Amended BiOp.

With respect to Missouri's contention that the Corps should have formally supplemented the FEIS rather than rely on an EA, Judge Magnuson found that the Corps EA considered the environmental impacts of the new technical criteria set forth in the revision and that these impacts did not present significant environmental consequences than had been already analyzed in the Corps Master Manual EIS to which it was tiered. The Court found that the first pulse was relatively small and was not a significant departure from the current water control plan. The second pulse, the May pulse, was similar to rises already studied in the FEIS and, thus, would not present environmental impacts substantially different from the alternatives previously analyzed. These findings led to the Court's conclusion that, although a bimodal spring rise was not studied in the FEIS, it did not present a "seriously different picture of the environmental impacts."

The Court also found that the Corps use of an EA to determine that a Supplemental EIS (SEIS) was not required was permissible. In so holding, the Court found that NEPA does not require the use of any particular document to analyze whether to supplement an EIS nor is it required to issue a FONSI. The Corps may base its decision to forego a SEIS merely on the fact that a revision does not provide a seriously different result than what was previously considered. The Court also held NEPA did not require the Corps to circulate an EA for public involvement or comment. The Court concluded that, based on its review of the administrative record, the Corps made a sound decision not to supplement the FEIS as there were no substantial changes in the proposed action and there was no significant new information bearing on the proposed action.

Missouri's argument that the Corps did not consider an adequate range of alternatives was also denied by Judge Magnuson. The Court found that the Corps had considered numerous alternatives in both the EA and by tiering and linking the EA to the FEIS. Thus, the Court held that the Corps complied with NEPA in its consideration of a range of alternatives to the Revision.